REPORT OF THE DEPARTMENTAL COMMITTEE ON Foot-and-Mouth Disease 1952—1954

Presented by the Minister of Agriculture and Fisheries to Parliament
by Command of Her Majesty
July 1954

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DEPARTMENTAL COMMITTEE ON FOOT-AND-MOUTH DISEASE

MINUTE OF APPOINTMENT

I hereby appoint:

Sir Ernest Gowers, G.B.E., K.C.B.

Professor E. D. Adrian, O.M., M.A., M.D., P.R.S., F.R.C.P.

Colonel H. Cator, M.C.

Ll. Wyn Griffith, Esq., O.B.E., D. Lit.

Lord Hungarton

Professor A. Robertson, M.A., B.Sc., Ph.D., M.R.C.V.S., F.R.I.C., F.R.S.E.

A. R. Semple, Esq.

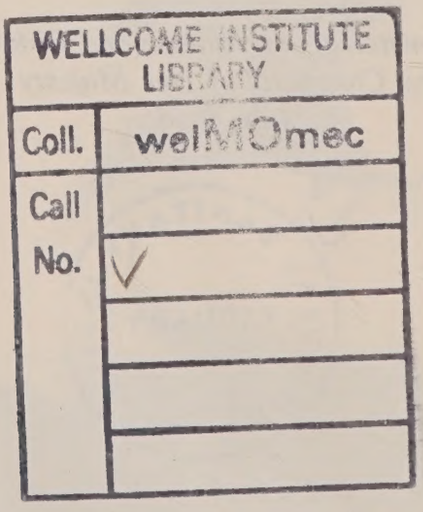
H. Woolley, Esq.

to be a Committee to review the policy and arrangements for dealing with foot-and-mouth disease in Great Britain, and to advise whether any changes should be made in the light of present scientific knowledge and the technical and administrative experience gained in recent years in this and other countries.

I further appoint Sir Ernest Gowers to be Chairman of the Committee, and Mr. R. A. Thorne, M.B.E., to be Secretary, and Mr. J. S. W. Henshaw to be Assistant Secretary of the Committee.

(Sgd.) TOM DUGDALE
Minister of Agriculture and Fisheries.

11*th September,* 1952.



NOTE.—The honour of a Knight Grand Cross of the Most Honourable Order of the Bath was conferred upon Sir Ernest Gowers in January, 1953.

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NOTE.—The estimated cost of preparing and publishing this Report is £12,237–15s., of which £387–15s. represents the estimated cost of printing and publication.

REPORT OF THE DEPARTMENTAL COMMITTEE ON FOOT-AND-MOUTH DISEASE

To the Rt. Hon. Sir THOMAS L. DUGDALE, Bart., T.D., M.P.,
Minister of Agriculture and Fisheries

SIR,

We were appointed by you on the 11th September, 1952:—

> "To review the policy and arrangements for dealing with foot-and-mouth disease in Great Britain and to advise whether any changes should be made in the light of present scientific knowledge and the technical and administrative experience gained in recent years in this and other countries."

We now have the honour to submit our Report.

We have held 39 meetings in Great Britain, four of them in Scotland and one at the Research Institute at Pirbright, and we have received evidence, either in writing or orally or both, from the persons and bodies listed in Appendix I. In addition, most of us visited France, Switzerland, Belgium, Holland, Denmark, Norway, Sweden, Brazil and Argentina. The European countries were selected because they provided the most convenient opportunity of observing in action all the three current methods of controlling foot-and-mouth disease—vaccination, stamping-out by slaughter, and a combination of the two. We thought it our duty to visit Argentina because the claims made for the methods of vaccination practised in that country were, we think, one of the factors leading to our appointment. On our way to Argentina we visited the Pan-American Foot-and-Mouth Disease Centre at Rio de Janeiro. While we were in France the Director of the International Office of Epizootics was good enough to give us the benefit of his wide experience, and in Sweden the International Veterinary Congress extended to us the privilege of being present at their Session on foot-and-mouth disease.

In all the countries we visited the representatives of the Government, the members of the veterinary profession and the farmers gave us every opportunity of getting full information about the working of the control system practised in their country. We should like to express our gratitude to them for the facilities they gave us, for their patience in answering our numerous questions and for the kindness and courtesy with which we were everywhere received. We should also like to thank the Food and Agriculture Organisation of the United Nations for permitting their Chief Veterinary Consultant to give evidence before us, as well as the Governments of numerous countries besides those we visited for the help they gave us by answering a questionnaire we sent them. Finally, we must record the debt of gratitude we owe to our many witnesses in this country for the time and trouble they gave to helping us with their evidence, both written and oral.

A complete summary of our Conclusions and Recommendations is given in Chapter VI.

CHAPTER I

THE NATURE* AND INCIDENCE OF FOOT-AND-MOUTH DISEASE

1. Foot-and-mouth disease is caused by a filter-passing virus: that is to say an organism so small that it can pass through the minute pores of a filter capable of holding back ordinary bacteria. Animals susceptible to the disease are cattle, sheep, pigs, goats and wild ruminants, and to a much less degree hedgehogs and rats. Laboratory animals such as guinea-pigs, mice and rabbits can be infected artificially with the virus, but are not susceptible to natural infection. Human beings have occasionally been infected, but authenticated cases are rare. The salivation and lameness that are the typical outward symptoms of the disease, and give it its name, are caused by blisters appearing on the tongue and the inside of the mouth and on the feet. Animals that contract the disease do not generally die. Among adult stock the ordinary mortality rate does not seem to be more than 2 to 3 per cent., though it may be much higher if the disease is of a specially virulent type, and it is always high in unweaned stock. The disease usually runs its course in two to three weeks.

2. The seriousness of foot-and-mouth disease lies not in the loss of animals by death but in its interference with productivity, especially by its after-effects on those that recover. In steers, sheep and pigs these are not necessarily grave, though they may sometimes be so, and at the best the animal will suffer a sharp temporary setback. But in dairy cattle they are more likely to be disastrous. The evidence we took in countries where the disease is endemic about the nature and frequency of serious consequences was diverse ; no doubt they vary with such factors as the type of outbreak, the degree to which endemic disease may build up its own resistance, and the extent to which vaccination may mitigate its virulence. But the information given to us in these countries, and our own observations on farms that had been attacked by the disease, showed that the after-effects included not only loss of condition and of milk-yield, but also abortion, sterility, heart affections, loss of hooves and chronic lameness from secondary infection, and inflammation of the udder, sometimes leading to its permanent impairment. Even in countries where the disease is endemic, and some natural resistance has been built up by previous attacks, many cows become totally unproductive. Estimates of the proportion that have to be destroyed for this reason vary. In Italy it is said to be " sometimes 50 per cent.", but that is exceptional. The average is much lower ; in France it is given as 5 per cent. We were told in Belgium that complete recovery from the after-effects is rare and takes a long time. We also obtained from some Continental countries estimates of the financial losses caused by the great epidemic of 1951-52 : they are set out in the following Table.†

		Animal population
France	£45 million ...	(16 million cattle, 8 million sheep and 7 million pigs).
German Federal Republic ...	£40 million ...	(11 million cattle, 2 million sheep and 14 million pigs).
Belgium	£7 million ...	(2 million cattle, 200,000 sheep and 1 million pigs).
Holland	£1 million ...	(3 million cattle, 400,000 sheep and 2 million pigs).

These figures, though not exactly comparable, since their basis is not quite the same, represent roughly the direct losses from death, the destruction of

* A fuller description is given in Appendix II.

† In Great Britain £3 million was paid as compensation for animals slaughtered during the epidemic. The animal population was 9 million cattle, 21 million sheep and 4 million pigs.

unproductive animals, and the fall in milk and meat production. The direct losses over the whole of Europe in that epidemic have been put by the Food and Agriculture Organisation of the United Nations at £143 million, and the indirect losses are said by the same authority to have probably been even greater.

3. Although the examination of particular cases and the experiences of particular countries show that the after-effects on livestock are of variable severity, it is clear that they are always damaging, often serious and sometimes disastrous. Animals may remain infective for a very long time. Moreover the disease is unique in the nature of its infectivity ; there seems to be little or no natural resistance to it among cloven-footed animals, so that, if unchecked, it spreads rapidly through the ruminant and pig population. Every diseased animal soon after infection, and even before it is showing symptoms, is an active producer of virus, which can be readily spread not only directly from animal to animal but also by many intermediate agencies such as human beings, vehicles, feeding utensils, packing materials, domestic animals, vermin and possibly birds and the wind.

4. There are several varieties of the virus. An animal which has recovered from infection by one variety has little if any protection from attacks by any of the others ; and it has only transient protection against further attacks by the same variety. Animals may thus have more than one attack of the disease in quick succession, and the effect will be cumulative. About the ways in which it is spread we shall have more to say when we come to consider the precautions taken to prevent it from doing so. Here we are concerned only with the fact that it does spread with appalling speed and range. As the *Departmental Committee of 1924 observed,

> " The real trouble with foot-and-mouth disease is not its deadliness but its extraordinary infectivity, and we do not have to consider its effect upon the animals actually attacked but upon the flocks and herds of the United Kingdom as a whole. . . . If once foot-and-mouth disease were allowed to become endemic, the total losses which would be suffered by traders and dairy farmers would be gigantic, and all stockowners would be faced with a constant and recurring menace, to say nothing of the effect on our export of pedigree stock, which is of such importance to the meat and wool trade of the world ".

This is unfortunately no less true today than it was 30 years ago. The eminent members of the veterinary profession who gave evidence before us on behalf of the Royal College of Veterinary Surgeons went so far as to say that, in their opinion, if the disease became endemic in this country the milk supply " would collapse ".

5. Our evidence leaves us in no doubt on two points. One is that this disease would rapidly establish itself as endemic in any country that failed to take energetic and rigorous measures to prevent it. The other is that if it were to do so in this country the result would be a national calamity.

The incidence of the disease during the years 1929-53

6. The geographical distribution of foot-and-mouth disease is almost world wide. A few countries enjoy exceptional freedom. It has never been known in New Zealand ; Australia has not had an outbreak since 1872, and it had not occurred in Canada until there was an outbreak in 1952. In the United States there has been no case in the last 25 years and in Ireland none since 1941. The comparative immunity of these countries is not due to any peculiar resistance in the animals there ; on the contrary, they are likely

* Report of the Departmental Committee appointed by the Minister of Agriculture and Fisheries to consider the outbreak of foot-and-mouth disease which occurred in 1923–1924—Cmd. 2350.

to be more susceptible than animals in countries where the disease is endemic.* The explanation lies partly in the favourable geographical position of the countries in question and partly in the stringency of their regulations to prevent the introduction and spread of the disease.

7. Over most of the rest of the world the disease is endemic. It is so in the greater part of South America, throughout Asia, and in most African territories. It is also endemic over most of Europe, although in a few countries, such as Finland, Sweden and Switzerland, it would perhaps be more accurately described as sporadic with occasional epidemics, as it is in Great Britain. In Norway it is rare. The Table facing page 10 shows the outbreaks in North Western European countries and Great Britain during the 25 years 1929-53. A graph is given in Appendix IV. Although the pattern is not quite the same in each country (there were, for instance, epidemics in Great Britain in 1941-42 and in Holland in 1943-44 that were peculiar to those countries), the figures show both how firm a hold the disease has in most of these Continental countries and also that, when an epidemic occurs, it is almost impossible to localise. In France there were only four of these twenty-five years in which outbreaks were counted in less than thousands, in Germany only three and in Holland only six ; in Belgium the position was not significantly better. In the great epidemic of 1937-40 (when there were some 400,000 outbreaks in France, 700,000 in Germany, 260,000 in Holland and 120,000 in Belgium) the disease spread with such violence that in Denmark and Sweden, which had been almost free for some years, there were 100,000 and 7,000 outbreaks respectively, and the disease invaded even Norway, where there had been no case for ten years. In the hardly less serious epidemic of 1951-52 the story is the same. Outbreaks in the endemic countries were in France 330,000, the German Federal Republic 200,000, Belgium 58,000 and Holland 27,000. At the same time there were 27,000 outbreaks in Denmark, where the annual average during the preceding ten years had been no more than 120, and 830 in Sweden, which had been almost free for the same length of time ; and again Norway (four outbreaks) did not altogether escape.

8. Turning now to the figures for Great Britain during the twenty-five years under review, we find that there were fifteen years in which the number of outbreaks was less than 100 ; and in eight of these it was under 50. Only in three years did the number exceed 200. The lowest number of outbreaks was eight in 1930, the highest 670 in 1942, and the average 129.† We escaped comparatively lightly at the time of the Continental epidemic in 1937-40, but had an epidemic of our own in 1941-42, when the disease was practically quiescent on the Continent ; on this occasion more than half the primary‡ outbreaks were attributed by the Ministry to infection from imported meat, a subject to which we shall return (page 14). In the first year (1941) there was a rapid spread of the disease owing to the exposure of infected animals in three markets in Herefordshire, Shropshire and Cheshire. The exceptionally large number of secondary‡ outbreaks in the second year was attributed by the Ministry partly to the fact that the

* Ireland has been invaded only five times in the last 50 years, but on the last occasion there were over 550 outbreaks, and in the United States in 1924 no fewer than 164,000 animals were slaughtered before the disease was eradicated.

† The average number of animals slaughtered annually between 1929 and 1953 was 5,800 cattle, 6,300 sheep and 3,000 pigs. In other words, on the average throughout Great Britain, 6 in every 10,000 cattle, 3 in every 10,000 sheep and 7 in every 10,000 pigs have been slaughtered each year.

‡ A " primary " outbreak is one which has no established connexion with a known outbreak in this country. A " secondary " outbreak is regarded as arising from established infection in this country. It is clear that, unless the origin of an outbreak is established with certainty, this classification has an element of conjecture in it. But it is made with great care and we think the figures may be regarded as broadly accurate.

YEARLY OUTBREAKS OF FOOT-AND-MOUTH DISEASE IN CERTAIN EUROPEAN COUNTRIES. 1929—1953.

Country and its present animal population	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953
Great Britain Cattle—10 million Sheep—22 million Pigs—4 million	38	8	97	25	87	79	56	67	187	190	99	160	264	670	27	181	129	54	104	15	15	20	116	495	40
France Cattle—16 million Sheep—8 million Pigs—7 million	22,147	6,555	10,878	9,449	42,212	3,177	2,140	524	160,412	218,291	20,157	61,611	19,466	1,229	147	340	377	28,012	8,046	13,248	17,481	8,094	10,040	320,016	5,513
Belgium Cattle—2 million Sheep—200,000 Pigs—1 million	461	1,071	612	4,076	28,755	842	18	18	63,262	39,501	9,797	11,286	2,148	272	63	7,135	297	9,354	1,557	1,933	1,173	408	50,359	8,943	2,551
Holland Cattle—3 million Sheep—400,000 Pigs—2 million	954	30,301	11,958	10,857	36,561	10,593	252	40	94,522	112,886	57,705	3,468	9,404	11,474	37,342	20,247	2,029	22,667	577	878	3,141	2,485	20,751	7,054	308
Denmark Cattle—3 million Sheep—50,000 Pigs—3 million	31	1,688	10,773	5,903	659	22	9	5	13	98,211	7,699	4,558	159	213	9	74	234	398	20	3	95	8	23,492	4,277	210
Germany (1938) Cattle—16 million Sheep—4 million Pigs—18 million	4,752	38,359	26,416	18,869	1,044	660	3,149	371	37,026	666,576	—	—	—	—	—	—	—	*German Federal Republic* Cattle—11 million Sheep—2 million Pigs—14 million	3,800	2,600	583	149,728	54,572	2,012	
Norway Cattle—1 million Sheep—2 million Pigs—500,000	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	(1938–39) 21		(1940–41) 86		2	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	2	2	Nil
Sweden Cattle—2½ million Sheep—250,000 Pigs—1½ million	2	14	155	47	2	Nil	Nil	Nil	Nil	4,435	2,818	45	3	9	Nil	Nil	3	2	Nil	Nil	5	Nil	459	374	1
Switzerland Cattle—2 million Sheep—200,000 Pigs—1 million	2,484	197	43	18	12	8	3	Nil	273	11,246	7,888	130	31	5	19	3	6	25	12	30	20	21	317	109	14

To face page 10

disease occurred in mid-summer in a very heavily stocked part of the West Country so that isolation would have been difficult even in normal times, and partly to the presence of large numbers of holiday-makers and evacuees, who spread infection by using the foot-paths across the pastures. Another cause was presumably the difficulties created by war-time conditions generally.

9. In 1951-52 we were less fortunate than in 1937-40. The disease reached this country on 14th November, 1951 and was not eradicated until 4th November, 1952, after the occurrence of some 600 outbreaks and the slaughter of over 85,000 animals. A full account of this epidemic is given in Appendix V and the lessons to be learned from it in controlling the spread of the disease are discussed in Chapter V. But one feature of it deserves mention at the outset of our Report.

10. The epidemic started with two outbreaks on the East Coast, one in Yorkshire and the other in Essex. The virus was the same highly virulent type as in the Continental outbreaks—a type making its first appearance in this country since 1944. These were followed within a week by no fewer than 20 primary outbreaks along the East Coast from Yorkshire to Essex. Further primary outbreaks followed ; nearly all of them were concentrated in East Anglia until the end of the year ; some continued in Suffolk and Essex up to April, 1952. At the beginning of that year the disease on the Continent had spread further west and Northern France had become heavily infected. This movement was reflected on our side of the Channel. At this stage of the epidemic the largest number of primary outbreaks occurred in Kent, and East and West Sussex had the next highest numbers, in that order. Later, as the disease moved westwards in Northern France, primary outbreaks occurred in Hampshire and the Isle of Wight, then in Wiltshire, then in Dorsetshire and finally in Devonshire. The inference seems irresistible that, by some means or another, virus from the Continent constantly crossed the sea to the nearest point on our shores.

CHAPTER II

CAUSES OF PRIMARY OUTBREAKS IN GREAT BRITAIN AND PRECAUTIONS AGAINST THEM

11. The Ministry have supplied us with the following Table which sets out what they believe to be the most likely causes of the primary outbreaks in this country since 1st April, 1938, when the State Veterinary Service was set up.

	Number	*Percentage*
Birds	88	16
Swill	214	40
Contact with imported meat and bones (other than in swill)	50	9
Infected serum (used in 1938)	1	—
Unknown origin but possible contact with swill, etc.	36	7
Origin completely obscure	151	28
Total number of primary outbreaks ...	540	

12. The virus of foot-and-mouth disease, though it can easily be destroyed by heat, sunlight or certain disinfectants, may remain active for a long time in a suitable medium such as the frozen or chilled carcase of a diseased

animal and on any material contaminated externally. Experiments at Pirbright have shown that the virus remains active on hay, for example, for at least 15 weeks.* The possible ways in which it may be introduced into this country were divided by the 1924 Committee into the "uncontrollable" and the "controllable". We shall adopt the same convenient division.

Uncontrollable

13. The uncontrollable agents that come under suspicion are now, as they were then, birds and the wind.

Birds

14. The possibility that birds may bring the virus to us from the Continent has attracted so much interest that we have added an appendix (Appendix VIII) setting out in detail the evidence given to us on the subject. Here we will only record our conclusions with a brief statement of the reasons for them.

15. It has been proved that the virus can be carried mechanically by any moving agency. The possibility of its carriage by birds has been demonstrated by small-scale experiments carried out at Pirbright Research Institute. A starling was externally contaminated on the feet and feathers, and the virus was recovered from the bird 91 hours later. These experiments also included the infection of some starlings by the mouth, and virus was recovered from their droppings from 10 to 26 hours after ingestion of the contaminated material. But the experiment did not show that starlings actually contract the disease and multiply the virus. The present evidence is that, if they are carriers, they are purely mechanical ones.

16. It is known that starlings migrate to England in large numbers from countries in Europe where the disease is endemic, that their cruising speed is about 40 miles an hour, and that their numbers have been increasing in recent years. They could come from an infected farm on the Continent to an English pasture well within the time that virus has been found active on their feet and feathers in artificial conditions. Whether it would survive as long in natural conditions, exposed to the sun, rain and wind, we do not know, but we have no ground for saying it is impossible.

17. There is therefore strong evidence that the starling is a potential carrier. There is no direct evidence that the disease is in fact brought by him; no witness put it any higher than that in some places flocks of starlings had been in the neighbourhood before an outbreak occurred. The case against the starling as an actual carrier rests on circumstantial evidence only; in the epidemic of 1951-52 primary outbreaks of obscure origin were relatively more frequent within 15 miles of the coast between Lincolnshire and Dorset than elsewhere; the type of virus was the same as that on the other side of the North Sea and English Channel; as the epidemic moved south-west along the Continental coast outbreaks followed it on this side; and no other explanation seems as probable.

18. The case against the starling is thus formidable, but it has not been proved. One of our witnesses suggested that a test should be made by arranging for a small herd to be constantly fed and grazed beside a

* We have been told of an outbreak in the U.S.A. of which no other explanation could be found than that it might have been caused by hay infected a year before during an outbreak at the same farm. A partly-used store of hay had been built up after the first outbreak and the second occurred when the store had been reduced to its original level.

large starling roost, but we cannot think that such an experiment would be either necessary or desirable. As this witness said, "If the starling is convicted without a shadow of doubt, what can you do about it? Beyond the satisfaction of conviction, no sentence can be pronounced. To destroy the species would be impossible and to reduce their numbers, a doubtful expedient, would require co-operation throughout Europe and well beyond the Iron Curtain".

19. The only answer can be that our suspicion of the starling reinforces the need for adequate measures to deal with the disease if he does bring it. It also emphasises the importance of treating foot-and-mouth disease as an international question (see paragraphs 88-90).

20. Starlings are singled out as the culprits because of their migratory routes, their numbers, their dirty and restless habits and their custom of feeding on pasture, associating with cattle and entering farm buildings. Suspicion has also fallen on seagulls, because they cross the Channel from countries where the disease is endemic and because of their habits of feeding on ships' swill, regurgitating their food, and frequenting pasture. We have no evidence that the disease is ever carried this way, but it is undoubtedly possible. The seagulls may be as serious a danger as the starlings, and the problem they present is no less intractable.

21. Some of our witnesses thought it probable that the disease was also brought to this country from the Continent by racing pigeons, and we made some enquiries into the circumstances in which these races are held. It appears that the races from the Continent take place in June and July only. About 100,000 birds in all take part. They are taken out in hampers by train and released from places in France, Germany, Belgium, Holland and Spain. They could no doubt convey the virus mechanically if they came into contact with it, but they are unlikely to do so except possibly by alighting en route. This they very rarely do: they are released at dawn, and most races are a single flight, finishing the same day. The only race in which birds are likely to spend the night at rest on the Continent is that from Spain, and if they do it is most improbable that they would alight anywhere in England before reaching their lofts.

22. There seems therefore to be small reason to suspect racing pigeons, and the exhaustive investigations that are made into the cause of every outbreak have never disclosed any evidence against them. At the worst, any danger there may be from them must be insignificant in comparison with the danger always present from wild birds coming from the Continent. Observations recently made by the Ministry showed that over the Kent coast alone some 750,000 birds came to this country from the Continent last autumn. Nevertheless, it is possible to imagine circumstances, during a severe epidemic on the Continent, when it might be prudent to eliminate from this standing danger the small element in it that is preventible. The Ministry already have power to prohibit the release of racing pigeons from premises in Infected Areas in this country, and we recommend that this power should be extended to cover the prohibition of pigeon racing to Great Britain from abroad and the racing of foreign pigeons from this country to the Continent. We think that occasions justifying its use for this purpose will be rare.

Windborne infection

23. The theory that the virus may be carried into this country by the wind is not new; it has long been known that pollen and insects can be windborne for over a hundred miles. Saliva from infected animals has

often been observed to be carried off by the wind, and it has been proved experimentally that, for a short distance at any rate, the virus of foot-and-mouth disease can be carried through the air. When we visited the Scandinavian countries we found that the veterinarians there were convinced that this is the most usual way in which infection reaches their countries. In Denmark they could find no other explanation of the fact that infection from Germany comes less frequently across the land frontier to Jutland than across the water to the Islands, and that outbreaks usually occur at times of strong southerly or south-westerly winds when disease of the same type is prevalent in Northern Germany. Similarly in Norway and Sweden it was said that the primary outbreaks that sometimes occur in isolated farms in the southern part of the Scandinavian peninsula when there is an epidemic in Denmark, and the wind is blowing from that direction, cannot be accounted for in any other plausible way. We record these views as a matter of interest without attempting to draw any conclusions about our own sources of infection. Over the greater part of our eastern and southern coasts, where, as we have seen, most of our primary outbreaks occurred in 1951–52, the distance the virus would have to travel is much longer. Our expert witnesses on the whole thought it unlikely that the virus could long survive when airborne, if exposed to sunlight, but one whose opinion carries exceptional weight thought it could survive through a whole night if the weather were cold. Here again the only lesson is that the bare possibility of our being invaded in this insidious way is the greater reason for preparedness in this country and for international action to reduce the incidence of the disease on the Continent.

Controllable

Imports of animals, carcases and meat

24. Measures have long been taken to prohibit or control imports in this category that might be dangerous. The arrangements for controlling the imports of livestock are set out in Appendix IX. The importation of carcase meat and other animal products is now governed by a new Order which consolidates and brings up to date the various Orders that previously existed. This is reproduced as Appendix XI. Here we need say no more than that the existing arrangements seem to be fully effective except in one respect.

Swill

25. The exception is the chilled and frozen meat that we import from Argentina (and to a much smaller extent from Brazil, Uruguay and Chile), where the disease is endemic. This is thought by the Ministry of Agriculture to be responsible for more primary outbreaks in England than any other single cause. Experiments by the Pirbright Research Institute have proved that the foot-and-mouth disease virus could live as long as four to five months in chilled and frozen meat. It had already been established that the virus could survive for over two months in bone-marrow at temperatures ordinarily used in the meat trade, but these later researches disclosed risks not previously realised: they showed both that the virus may survive elsewhere than in marrow and also that its viability is much longer than had been supposed. When the virus arrives here in this way it may be spread from the swill-tub: scraps of waste meat, or other waste food contaminated by it, get into the swill, and pigs contract the disease. Cattle also may do so if they have access to infected swill or bones from infected imported carcases that are thrown on the garbage heap or given to dogs.

The Ministry have supplied us with the following Table:—

Primary outbreaks, 1938–1953

Year	Total number of primaries	Primaries attributed to swill, etc.	Primaries of unknown origin but in which there was possible contact with swill, etc.
(1)	(2)	(3)	(4)
1938 (from 1 April)...	21	5	3
1939	23	6	1
1940	28	14	3
1941	16	9	—
1942	40	23	5
1943	6	4	2
1944	93	76	5
1945	66	60	4
1946	34	23	1
1947	22	12	—
1948	6	3	—
1949	7	2	3
1950	14	11	1
1951	57	3	2
1952	82	—	2
1953	25	13	4
	540	264	36

Total of columns (3) *and* (4) = 300 = 56 *per cent. of total primaries.*

26. As we have seen, the epidemic of 1951–52 was due mainly to virus from a European epidemic conveyed across the sea, presumably by birds and possibly by the wind. The figures of those years are therefore not typical, and to get a true picture of the danger from swill in normal times they should be omitted. If this is done, the percentage of primary outbreaks attributed to swill, or of which swill was a not unlikely cause, rises to over 70. This source of infection is clearly of great importance, and we must consider in detail the precautions taken against it. These consist both of measures designed to prevent infected meat from being exported to this country from South America and of measures designed to ensure the sterilisation of swill fed to animals in this country.

27. As to the first, the Governments of Argentina and the other South American exporting countries have agreed to apply the following control arrangements.* They apply to cattle, sheep and pigs.

(*a*) Animals destined for export must be inspected by a Government Veterinary Inspector at the farms of origin and the farms must be certified free from foot-and-mouth disease.

(*b*) Animals intended for slaughter and export which are first sent to markets, sales or exhibitions must be inspected again by a Government Veterinary Inspector and certified to be free from foot-and-mouth disease before being moved to the freezing plant for slaughter.

(*c*) Animals must be further inspected at the freezing plants before and after slaughter and certified to be free from foot-and-mouth disease.

* Commonly known as "The Bledisloe Agreement" of 1928.

(*d*) If any animal is found to be infected at the freezing plant, the whole troup is isolated and no carcase (or offal) from that troup may be exported to Great Britain ; and the by-products are required to be submitted to suitable treatment to prevent any possibility of contagion.

(*e*) Packings, coverings and wrappings of meat for export are required to be entirely new.

(*f*) All places which may have become infected must be cleansed and disinfected under the supervision of the Government Veterinary Inspector at the freezing plant.

(*g*) All vehicles carrying livestock are required to be cleansed and disinfected after every unloading.

28. We investigated the working of these restrictions when we were in Argentina. We found that, owing to the comparatively small number of veterinary officers employed, and the long distances to be travelled, the veterinary inspection at the farm of origin is not always made, but a declaration by the farmer is accepted instead. With that exception the agreement seems to be observed. But these precautions cannot wholly avert the risk that meat may occasionally be exported from animals that were incubating foot-and-mouth disease at the time of slaughter. Veterinary inspection immediately before and after slaughter should normally result in detection of the disease if it has developed, but cannot be relied on to reveal whether an animal is incubating it. There is thus a danger that among the carcases exported to this country may be those of animals which have picked up infection while on their way from farm to freezing plant, or of animals which have left a farm while in the incubative stage, before disease has been detected there. The only complete protection against this would be to quarantine the animals at the freezing plant, and this is obviously impracticable.

29. So long as we have to import meat from South America, and so long as foot-and-mouth disease is endemic on that Continent, there must always be a risk that meat coming from there may occasionally be contaminated. Two British Veterinary Officers are stationed in Argentina to assist in securing observance of the control arrangements, and we were impressed by the efficiency and tact with which they seemed to us to be performing a difficult and delicate task.

30. We must now turn to the measures taken in this country against the danger of outbreaks caused by the presence of the virus in waste food. As we have said, this danger arises in two ways. One is that contaminated food may be fed to pigs in swill. The other is that it may be left in a place where susceptible animals may have accidental access to it, or where birds, dogs or vermin may get at it and drop pieces within reach of susceptible animals, as happened in Scotland in 1952 with disastrous results. (See paragraph 140.)

31. It was to meet these dangers that the Boiling of Animal Foodstuffs Order was made in 1927. This Order* (as amended in 1947) is still in force. It requires that swill shall be boiled for an hour before being fed to animals or poultry, and that before boiling it shall be so kept that no animal or poultry shall have access to it. Up to 1942 no other precaution was required by law against the risk of conveying disease by feeding contaminated swill. And indeed, if the Order were invariably strictly observed, no other precaution would be necessary: it would provide a complete

* The Diseases of Animals (Boiling of Animal Foodstuffs) Order of 1947 is reproduced as Appendix X.

safeguard. But in fact it is a very imperfect one: it is almost impossible to enforce, and its voluntary observance is subject to the hazards of ignorance or neglect.

32. In 1942, action taken by the Government for a different purpose had the effect of introducing in some places an additional precaution at an earlier stage. The exigencies of war had made kitchen waste a most valuable contribution towards conserving the food resources of the country. Some local authorities—the Borough of Tottenham was an outstanding pioneer—collected kitchen waste separately from other refuse, processed* it, and sold it to pig and poultry keepers. The Government gave directions under the Defence Regulations to some 320 local authorities to follow this example. They were mostly urban authorities, and covered about half the country. They were required to collect kitchen waste separately from other refuse and, before disposing of it, to process it or to hand it over to another local authority for processing. Private collection of kitchen waste in the areas of those local authorities was forbidden, except that existing collectors were allowed to continue (but not to extend) their activities under licence requiring that what they collected must be processed or sterilised in a plant approved by one of the veterinary officers of the Ministry of Agriculture. Over the rest of the country, which included most rural areas, anyone was still free to collect kitchen waste and either sell it or feed it to his own animals, subject only to the provisions of the Boiling of Animal Foodstuffs Order.

33. These arrangements are now breaking down because the circumstances that led to them have changed. It has become increasingly uneconomic for local authorities to deal in swill. The subsidies by which they were at first supported were withdrawn in 1951 ; the price control which afterwards helped them disappeared with the decontrol of feeding-stuffs in 1953 ; and the cost of labour and transport has steadily risen. At the same time swill is less in demand because the prices of other feeding-stuffs have fallen. One after another local authorities asked to be relieved of this obligation ; permission was always granted, and none are now bound to collect kitchen waste separately. Some of them are continuing to collect it and process it ; some collect and sterilise it without processing ; some collect it and dispose of it raw, and some do not collect it separately at all. In the Scheduled Areas† private collectors must still be licensed and their plant inspected and approved. This control is exercised under a Defence Regulation, and when that is abrogated it will no longer be possible without fresh legislation. But if the Defence Regulation that provides for these requirements is abrogated, the control of private collectors in Scheduled Areas will cease unless other arrangements for licensing them are adopted. Outside the Scheduled Areas the collection of kitchen waste is still uncontrolled, as it always has been. The Agriculture (Miscellaneous Provisions) Act recently passed by Parliament empowers local authorities to collect kitchen waste and to dispose of it for animal feeding-stuff, with or without processing. (Previously their only specific statutory power to deal in waste food was derived from the Defence Regulations.) The Act contains no other provisions on this subject, and the Government have indicated that they are awaiting our Report in order to review the whole question.

34. Although we are concerned only with foot-and-mouth disease, we cannot ignore the fact that raw waste food may also be a means of spreading

* "Processing" means sterilising by pressure cooking in a concentrator plant. The moisture in the waste is evaporated and the resulting product has a dry matter content of 35 per cent.

† i.e.: Those areas in which local authorities were required under the Defence Regulations to collect and process kitchen waste.

swine fever, fowl pest and other animal diseases. The case for precautionary measures, strong enough if foot-and-mouth disease were the only risk, is thus made even more cogent. Raw waste food has for years been branded as a danger by the law that forbids its being fed to animals untreated. It seems to us highly anomalous that any local authority (whose duty it is to be above reproach in matters of health and hygiene) should sell it to the public in that condition. Indeed we feel so strongly about this that we think it right to start with the premise that no solution is tolerable that permits this practice, whatever may be the consequences of prohibiting it.

35. We have no doubt what course would be ideally best. It would be for local authorities to be the sole collectors of kitchen waste, processing and selling as much of it as there was a demand for, and disposing of the rest in such a way that it could not become a source of danger. But this solution is in present circumstances clearly quite impracticable. Apart from other obvious objections, it would not be easy to persuade public opinion that the burden this would place on the ratepayer or taxpayer was justifiable. It might be substantial. Not only would few local authorities be able to carry on the business without loss (the City of Cardiff are reported to have lost £11,000 in a year) but it would also be necessary to pay compensation to several thousands of private collectors for loss of their trade. We have to seek a solution which, though less complete, is more realistic.

36. During the debate on the recent Act, Government spokesmen pointed out that one of the fundamental difficulties of this problem is that its solution ought not to be discriminatory. Yet to compel all collectors to sterilise would mean that less kitchen waste would be collected than is now ; to compel none would mean that more would be fed to animals untreated than is now. We agree that any compulsion that may be applied ought not to be discriminatory ; and since it is impracticable to compel all local authorities to collect kitchen waste separately, we do not think that any should be. But since we hold that a local authority which does collect it and dispose of it as animal food must sterilise it first, we think that this should be required of all collectors.

37. It cannot of course be literally all. There is obviously a case here for the application of the principle of *de minimis*. At the one end of the scale is the collector in a big way, who takes the kitchen waste from such places as Service camps, hotels, restaurants, hospitals and other catering establishments, and sells it to farmers. All these should be required to take out a licence imposing on them the same obligations as are imposed on existing licensed collectors. At the other end of the scale is the cottager with a backyard pig and a neighbour or two who let him have their waste. To subject him to the requirements of licensing would be absurd. It is not easy to suggest with confidence how the dividing line should be drawn between those whose business is so substantial that they ought not to be allowed to collect without having their plants approved and those whose activities are on so small a scale that it is unnecessary to include them. It would not do to draw the line between collection for sale and collection for the collector's own use ; there are many pig and poultry farmers who collect large quantities for their own use, and it is right that their sterilising plant should be subject to inspection. A possible dividing line would be between collectors from catering establishments and those who collect from private houses only ; the big collectors do not find it worth while to collect from private houses alone. Or there might be a general obligation on collectors to be licensed subject to exemption for the pig and poultry keeper in a small way who collected for his own use only. "In a small way" might be defined by providing for exemption to be obtainable on application

on the ground that the amount ordinarily collected was not large enough to need a special sterilising plant. Or all pig and poultry keepers whose stock did not exceed a specified number might be automatically excluded. We have not thought it necessary to delay our Report by taking the evidence that would be needed to enable us to express an opinion on which of these methods (and possibly others) would be best. We have no doubt that it would be possible to devise a workable, though perhaps imperfect, dividing line.

38. For the same reason we have not gone closely into the question what authority should administer such a licensing system. At present the veterinary staff of the Ministry are responsible for the licensing and supervision of the 2,500 licensed collectors in the Scheduled Areas. It is not known how many collectors there are elsewhere, but it is not unreasonable to suppose that bringing them in might more than treble this figure. In that case it might be better to decentralise the administration, and assign the work to the local authorities.

39. The Boiling of Animal Foodstuffs Order must remain in force to provide for those cases not covered by our recommendations. The field in which it remained the only safeguard would still be larger than we could have wished. But we do not see how that can be helped. Though measures for enforcement may not be practicable, we hope that the Ministry will take all possible steps to remind pig and poultry keepers of their legal obligation to boil their swill and to emphasise the great importance of doing so.

40. Our conclusions therefore are:

(*a*) that all local authorities should be empowered (but none should be compelled) to dispose of waste food for feeding to animals ;

(*b*) that all waste food, whether collected by a local authority or privately, to be used for feeding to animals, should be sterilised by the collector ;

(*c*) that all substantial collectors of waste food other than local authorities should be required to obtain a licence imposing on them an obligation to use an approved sterilising plant which would be periodically inspected ;

(*d*) that the question should be considered of assigning to local authorities the task of licensing collectors and inspecting their boilers or sterilising plant.

41. We recognise that this is not a wholly satisfactory solution of this baffling problem. Kitchen waste is still a valuable feeding-stuff, and to some extent a saver of dollars. It has been estimated that until recently it was being collected for this purpose at the rate of not less than 600,000 tons a year, worth perhaps £2,000,000. Our proposals would almost certainly mean that much less of it would be available than would be either if local authorities were compelled to collect and process it or if it were allowed to be collected and supplied to farmers untreated. But we have explained why we feel it necessary to rule out the first alternative, and as to the second we think that, if the choice is between wasting this food and supplying it untreated, the lesser evil is to waste it. Conditions today are very different from what they were when compulsory collection was first enforced. We were then at war, and enemy submarines had reached the peak of their success. Other feeding-stuffs are now plentiful. The fact is that the problem does not admit of any wholly satisfactory solution: weighty arguments can be brought against every conceivable course. After

giving much thought to the question, we have come to the conclusion that the one we have suggested is less open to objection than any other.

42. There remains the question of possible infection from kitchen waste on refuse dumps, a danger that is likely to increase if separate collection is progressively abandoned. It is, we understand, the responsibility of local authorities to dispose of refuse in such a way that it is not prejudicial to health or a nuisance. Their methods vary: some burn it; some dump it in the sea; some pulverise it and spread it on their refuse fields; some practise what is called "controlled tipping", which means that the refuse, after being tipped, is covered over at the end of each day. Others, especially in rural areas, just dump it in any convenient place, with few if any precautions to prevent access to it. Thus birds, dogs or vermin may get at it and drop pieces of contaminated food within reach of susceptible animals. That refuse containing waste food should ever be dumped in this way seems to us deplorable. The inference must be either that the statutory obligations of local authorities cannot be construed as imposing on them the duty of so disposing of their refuse as to involve no danger to animal health, or that the local authorities who dump their refuse in this way are not carrying out their statutory duties. If the first inference is the correct one, we think the law should be amended; if the second, we hope that every effort will be made by the Government Departments concerned to urge upon any such local authorities the great importance of faithfully carrying out this duty and to give them any advice that may be needed about how best it may be done.

Persons and motor vehicles arriving from the Continent

43. Several witnesses suggested that persons and motor cars arriving in England from the Continent ought to be disinfected. They thought that there was a risk of the virus being brought on the shoes or clothes of persons who had been walking over or picnicking in infected fields, or of its being conveyed in mud from infected roads adhering to the tyres of motor vehicles or the underside of their wings.

44. Precautions of this sort have been taken in some countries. In Eire, during the serious outbreaks in Great Britain in 1951-52, passengers were asked on arrival to declare whether they had been on a farm or had had any contact with farm animals or their carcases during the previous 28 days. If so they were required to submit themselves and their clothes to disinfection. All cars, motor-cycles and bicycles were also disinfected on arrival in the country. In Northern Ireland persons engaged in the cattle trade, such as dealers and drovers, are disinfected on entering, but no one else is. In Sweden cattle trucks arriving from the Continent are liable to disinfection, but the Swedish veterinary authorities have found that it is not practicable to disinfect them all as the traffic is too heavy. Cattle men and farm workers arriving in Sweden to work there are disinfected at the ports. Visitors to Norway who expect to be in contact with farm animals within three months of their arrival are required to submit themselves and their effects to disinfection. The Norwegian Government do not require motor cars to be disinfected on arrival. They think the risk is too slight to make this necessary or justifiable.

45. Our expert witnesses agreed that it is possible for the virus to be introduced in this way. But on the whole they doubted the practical value of disinfection in such circumstances. Some argued that, as the virus can be carried on particles of dust, disinfection to be really effective would have to be done with a thoroughness that would be an intolerable inconvenience to travellers. Some, however, thought it might be worth while

to require people arriving from the Continent to walk through trays of disinfectant and motor vehicles to be driven through disinfectant splashes, so as to destroy any virus that might be carried on shoes or tyres. Others thought it would be practicable and useful to spray the underside of the wings of cars or to wash the mud off with a pressure hose. No evidence has been produced in this country or any other country we have visited that the disease has ever been introduced in this way. In the absence of any such evidence we do not think it would be justifiable in ordinary circumstances to inflict the great inconvenience that thorough disinfection would cause, or worth while to require disinfection that was less than thorough. But persons and vehicles cannot be ruled out as a possible source of infection. We can imagine circumstances in which it might be thought wise to take precautions of this sort and we think the Ministry ought to have power to take them.

Hay and Straw

46. Except from certain specified countries which are normally free from the disease, the importation into Great Britain of hay and straw for use as fodder or litter for animals is prohibited. An Order made by the Ministry of Agriculture and Fisheries requires that hay and straw brought into this country as packing material shall not be allowed to come into contact with any animal susceptible to foot-and-mouth disease. We cannot say how closely this is observed, but we are informed that over the last 15 years no outbreak in Great Britain has been attributed to this cause.

Imported vegetables

47. This possible source of the introduction of the disease into this country could only be eliminated by prohibiting the importation of vegetables from countries where the disease is endemic. As no outbreak over the last 15 years has been attributed to imported vegetables there does not seem to be any case for such a prohibition.

CHAPTER III

METHODS OF COMBATING THE DISEASE

48. There are two main methods by which the disease is being combated. One is to slaughter animals that have been infected or exposed to infection. This is known as the " stamping-out "* (or " slaughter ") policy. The other is to try to establish immunity by means of vaccination. Some countries use one method only, some both. Whichever is used, it is ordinarily supplemented by other measures to prevent the spread of the disease, such as the disinfection of infected farms and the temporary prohibition of all movement from them. The supplementary measures used in Great Britain are set out in Appendix XII and are discussed in Chapter V. Those used in other countries are set out in Appendix XIII. We shall make little reference to them in the present Chapter, in which we shall consider the advantages and disadvantages of vaccination and stamping-out.

49. Only countries where the incidence of the disease is low rely wholly on stamping-out. These include Great Britain, Eire, Northern Ireland,

* The practice of eradicating the disease by slaughter is referred to internationally by the English phrase " stamping-out ". We therefore use this expression instead of " slaughter policy " throughout our Report.

Norway, Canada and the United States. The policy of vaccination without stamping-out is followed by countries where the incidence is high. These include France, Western Germany, Belgium, Italy, Spain and Argentina. Among the countries that adopt the two methods in combination are Switzerland, Denmark, Holland, Sweden and Finland. Vaccination was also combined with stamping-out in Mexico during the epidemic of 1946-51.

50. We will now briefly describe the ways in which these methods are carried out in certain countries, and the results claimed for them. The animal population figures given in this Chapter are those for 1952.

Stamping-out

Great Britain

(Cattle—9 million; sheep—21 million; pigs—4 million. Number of outbreaks 1951/52—611.)

51. As soon as the existence of the disease is confirmed, all animals suffering from it are slaughtered, as well as all susceptible animals that have been in contact with them. The object of slaughter is to destroy as quickly as possible all animals in which the virus is multiplying; and it is likely to be doing so in any animal that has been in direct contact with one suffering from this highly infectious disease. But it is less easy to determine whether there have been indirect contacts that would justify a similar conclusion. All cases are considered on their merits. If the Ministry's veterinary officers decide that the indirect contact is such as to make it highly probable that an animal so exposed will develop the disease, it is slaughtered. For example, animals in a market when infection is discovered there; animals that have been transported in vehicles recently used for the conveyance of stock subsequently found to be infected; animals that have been tended by a farm employee who has recently had direct contact with infected stock—all these would normally be condemned. But in doubtful cases the Officers are empowered to order the detention of a suspected animal so that they may keep it under observation. If the symptoms of the disease appear, it is slaughtered; if not, the animal is freed when the Officers are satisfied it is not developing the disease.

52. Stamping-out was first adopted in Great Britain in 1892. The ensuing thirty years were on the whole a period of comparative immunity—in twenty of them there were either no outbreaks or the number did not reach double figures (see graph, Appendix III)—and there was no difficulty in maintaining the policy. Its testing time came in 1922, when a serious epidemic broke out and lasted until 1924; in those three years there were over 4,000 outbreaks. Stamping-out was partly abandoned, and some infected herds were allowed to be isolated instead of slaughtered. Sixty-seven of the 1,125 outbreaks in 1922 were dealt with by isolation. The reason for this departure is set out in the following quotation from the *Report of the 1922 Departmental Committee:

> "At length, the gradual but effective diminution of the number of outbreaks demonstrated that the success of the stamping-out policy was within reach, but as it was still doubtful whether the object would be attained within the limit of expenditure sanctioned by the Cabinet†, isolation of affected animals was adopted where the circumstances were such as to provide adequate safeguards against the spread of the disease".

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* Report of the Departmental Committee on Foot-and-Mouth Disease appointed by the Minister of Agriculture and Fisheries in 1922. Cmd. 1784.

† For payment of compensation for slaughtered animals.

In the next paragraph of their Report the Committee said:

> "We are in agreement with the majority of the witnesses who have stated their opinion that the policy of slaughter is the correct one and should be maintained".

53. This view was endorsed by the 1924 Departmental Committee. They said:

> "The failure of 1923 was, in our opinion, due to the faulty manner in which the policy [stamping-out] was prosecuted rather than to any defect in the policy itself . . . . We are unshaken in our belief that, until a preventive agent is available, the slaughter policy should be continued".

Referring specifically to isolation of affected animals the 1924 Committee said:

> "The manufacture of virus is on a much greater scale [when affected stock are isolated instead of slaughtered] and continues for a long period, thus multiplying the risk of extension with the ultimate danger of an uncontrollable spread and of the disease becoming endemic in this country. A policy of isolation would be equivalent in our view to abandonment of any hope of eradicating the disease from this country".

54. Since then the stamping-out policy has been strictly maintained. The numbers of animals destroyed in each year between 1922 and 1953 are as follows:

Year	Number of outbreaks	Cattle *	Sheep *	Pigs *
1922	1,140	24,000	22,000	10,000
1923	1,929	69,000	26,000	33,000
1924	1,440	43,000	28,000	18,000
1925	260	9,000	8,000	3,000
1926	204	6,000	12,000	3,000
1927	143	5,000	3,000	2,000
1928	138	4,000	5,000	2,000
1929	38	1,000	1,000	1,000
1930	8	42	67	195
1931	97	4,000	6,000	1,000
1932	25	629	2,000	416
1933	87	3,000	3,000	1,000
1934	79	3,000	5,000	2,000
1935	56	3,000	7,000	3,000
1936	67	3,000	2,000	1,000
1937	187	9,000	15,000	7,000
1938	190	8,000	13,000	4,000
1939	99	3,000	5,000	4,000
1940	160	7,000	9,000	4,000
1941	264	13,000	11,000	3,000
1942	670	28,000	23,000	8,000
1943	27	1,000	2,000	1,000
1944	181	4,000	7,000	6,000
1945	129	3,000	2,000	6,000
1946	64	2,000	1,000	2,000
1947	104	5,000	2,000	3,000
1948	15	1,000	396	191
1949	15	733	373	2,000
1950	20	1,000	42	1,000
1951	116	6,000	4,000	3,000
1952	495	32,000	32,000	11,000
1953	40	1,000	5,000	1,000

* (Figures over 1,000 are rounded to the nearest thousand.)

U.S.A.

(Cattle—88 million; sheep—28 million; pigs—64 million. Number of outbreaks 1951/52—Nil.)

55. As in Great Britain, stamping-out means the slaughter of all infected animals and their contacts. Outbreaks of the disease occurred in the United States in 1902, 1908, 1914, 1924/25 and 1929. The outbreak in February, 1924, extended to 16 counties in California; 132,000 animals were slaughtered and it took 10 months to eradicate the disease. According to the Report of the Special Sub-committee to the Committee on Appropriations of the United States Senate about the control of foot-and-mouth disease (published in 1948): "Unusual difficulties were encountered in the spread of the disease to large range herds and flocks in rough, inaccessible, poorly fenced country, and to deer in a national forest". Another outbreak occurred in September of the same year in Texas, which had no apparent connexion with the California outbreak. This was got under control within 30 days, after the slaughter of 32,000 animals. The outbreak in 1929 was also quickly brought under control—"in a few weeks"—after the slaughter of 3,500 animals.

Canada

(Cattle—9½ million; sheep—2 million; pigs—5½ million. Number of outbreaks 1951/52—29.)

56. The only occasion on which the disease is known to have occurred in Canada was in 1951/52. It was stamped out by the slaughter of all susceptible animals both on the infected premises and on farms that had been exposed to infection. Altogether over 1,700 animals were killed. Nearly 1,700 poultry and over 13,000 eggs on infected premises were also destroyed. It took six months to eradicate the disease. Although it was not recognised as foot-and-mouth disease until February, 1952, subsequent investigations indicated that the first outbreak had occurred about the middle of the previous November and had then been diagnosed as vesicular stomatitis. The Canadian veterinary authorities came to the conclusion that the disease was conveyed to the country by an immigrant from an infected farm in Western Germany. He left that country on the 17th October, 1951, and was employed on a Canadian farm from the 2nd until the 5th November, 1951. Ten days after he had left the farm, the owner noticed that his pigs were off their food and were salivating*. Before the outbreak had been diagnosed as foot-and-mouth disease, the disease was found to have spread, in spite of the limited movement of livestock on account of winter conditions, to about a dozen other farms and also to a meat packing plant. The thoroughness with which the stamping-out method was applied is shown by the following extracts from a paper by Dr. Childs, the Canadian Veterinary Director-General:

> "It was realised that residual infection remaining on premises after affected livestock had been removed could not be certainly eliminated during the cold, freezing weather. To prevent possible dissemination from that source, immediately after the infected livestock had been removed, gangs of men under continuous Federal veterinary supervision moved in and collected and burned all hay, straw, feedstuffs, litter, etc.

* In a paper submitted by Dr. Childs, the Canadian Veterinary Director-General, to the Fifteenth International Veterinary Congress, he says: "When all details of the picture were painted in . . . it appeared obvious the immigrant . . . carried in his baggage or personal effects meat or meat products, derived from infected animals, probably in the form of summer sausage, the curing or processing of which was not sufficient to destroy the contained virus . . ."

> Then the interiors of all buildings involved, together with the yards, manure piles, etc., were drenched with a 2 per cent. solution of sodium hydroxide driven through spraying equipment by powerful pumps. The low sub-zero temperatures at that time necessitated heating at Regina the water used, and rushing it to the scene of operations in specially protected tanks mounted on trucks. . . . With the advent of warm weather and disappearance of snow, ice, and frost, disinfecting gangs returned to all premises involved, swept out haylofts, tore out all wooden floors, raked up all litter and rubbish and disposed of it by burning; accumulations of manure were burned or buried and barnyard surfaces shaved off to a depth of 4 to 6 inches with power equipment. The interiors and exteriors of buildings, fence posts, yard surfaces, and any other article which might in any manner harbour infection, were again drenched with 2 per cent solution of lye; machinery, vehicles, etc. were washed with 4 per cent. sodium carbonate solution. Following this treatment, the premises were left vacant of livestock for at least 30 days. . . . Disinfectant stations were established on all highways just outside the boundaries of the closely quarantined area for the purpose of disinfecting wheels and under-bodies of vehicles leaving that area. This procedure was of very doubtful value, but was advisable for the purpose of abating public clamor".

At the 1953 International Veterinary Congress the Canadian representative said that the disease could be, and had been, eradicated in Canada by stamping-out, and that vaccination would only be considered if the disease ever got out of control.

Norway

(Cattle—1 million; sheep—2 million; pigs—½ million. Number of outbreaks 1951/52—4.)

57. Since 1940–41, when 86 cases were confirmed, there have been only seven outbreaks in Norway. All the animals on an infected farm are slaughtered, including dogs and horses and poultry. The animals in contact herds are isolated and frequently inspected. If the symptoms of the disease appear, or even if there is suspicion, the isolated animals are slaughtered. The Norwegian veterinary authorities hold that "the fight against foot-and-mouth disease must be conducted like a military operation" and that immediate reporting of an outbreak is essential for the success of the stamping-out method. They have an arrangement under which telephone calls reporting outbreaks are given priority over all other calls except military "urgent priority" calls.

Northern Ireland

(Cattle—900,000; sheep—800,000; pigs—700,000. Number of outbreaks 1951/52—Nil.)

58. The last outbreak in Northern Ireland occurred in 1941 after ten years of freedom from the disease. Fifty-four cases were confirmed and 844 animals slaughtered. The disease, which was introduced by imported meat, took six months to eradicate. All infected and contact cattle, sheep and pigs are slaughtered.

Eire

(Cattle—4 million; sheep—3 million; pigs—700,000. Number of outbreaks 1951/52—Nil.)

59. Eire also had its last outbreak in 1941 after being free from the disease for 13 years. Although the source of the infection was not established, there was evidence which suggested that contact with the outbreaks in Northern Ireland was responsible. There were 556 farms involved. All infected and contact animals, and all animals suspected of having had contact, were slaughtered. Over 42,000 animals were destroyed. It took eight months to eradicate the disease.

Vaccination

Its problems

60. We have already referred to the fact that there are several varieties of the virus of foot-and-mouth disease and that an animal which has recovered from infection by one variety is not necessarily protected from attacks by any of the others. The varieties in Europe consist of three main types, known as A, O and C, and of variant strains which occur within those main types. Thus a vaccine to be fully effective must confer immunity against all the varieties of the virus: not only against the main types but against all within-type variants. Vaccine is manufactured from the attenuated virus of the variety or varieties against which protection is required, and there was general agreement among our expert witnesses that the greater the number of varieties contained in a vaccine the less likely it is to confer effective immunity against any of them. The countries that vaccinate have therefore been confronted with the problem of deciding:

(i) the varieties of the virus against which protection is needed ;

(ii) the maximum number of the varieties of the virus against which it is practicable to vaccinate ;

(iii) whether to produce:

(*a*) " monovalent " vaccines (that is vaccines which are specific to one variety of the virus) and to inject separately against each variety ;

(*b*) " bivalent " vaccines ;

(*c*) " trivalent " vaccines.

(A bivalent vaccine contains two strains and a trivalent three. They may be manufactured either by mixing the two or three infective materials in the preparation of one vaccine, or by preparing separate vaccines and then mixing them. The latter procedure is the more usual in the production of foot-and-mouth disease vaccine).

(iv) whether

(*a*) to store the known varieties of the virus, and manufacture vaccine of the particular variety required when an outbreak occurs (a practice that involves some delay before the protective vaccine becomes available) ; or

(*b*) to manufacture and store vaccines appropriate to some or all of the known varieties of the virus.

Apart from the known varieties of the virus in Europe, there are at least three different types in Africa, which are generally referred to as S.A.T. 1, 2 and 3. The difficulties experienced by the Continental vaccinating countries would be increased if the African varieties of the virus were to spread to Europe.

61. Before we describe the methods used in the European and South American countries that we visited, certain explanations are necessary.

(i) We have said that there are three main European types of the virus known as A, O and C. The classification of those varieties is uniform in Great Britain and in the foreign countries we visited. But at present there is no uniformity of classification of the many within-type variants. (See Appendix II.) It is not yet known whether the variant classified as A_5, for example, in one of the foreign countries is the same variant as bears that designation here or in any other country. This is also true of the within-type variants of virus O and virus C. The Pirbright Institute are now examining samples of all the varieties of the virus from Continental countries with a view to standardising the classifications.

(ii) We shall refer later to " Ring " vaccination and " Frontier " vaccination. " Ring " vaccination means the vaccination of susceptible animals within a certain zone around an outbreak. Its purpose is to limit the spread of the disease once an outbreak has occurred. " Frontier " vaccination means the vaccination of susceptible animals along a country's frontier to a given depth. The vaccination is done either periodically, with a view to maintaining a barrier of permanently immunised animals, or as a precautionary measure when the disease on the other side of the frontier appears threatening. In some cases all the susceptible animals in a zone or along a frontier are vaccinated and in others only the cattle.

France

(Cattle—16 million ; sheep—8 million ; pigs—7 million. Number of outbreaks 1951/52—330,000.)

62. The following is a summary of the information given to us in France. Vaccination was first practised in 1945. All cattle, sheep and pigs were then vaccinated in a zone some 20 kilometers in depth along the frontier with Spain, and the animals there are still vaccinated with bivalent (O/A) vaccine every Spring. The duration of the immunity conferred by vaccination was stated to be " six months at least ". The French veterinary authorities said that the practice has been successful in preventing the spread of the disease into their country from Spain. On the Swiss frontier also, in collaboration with the Swiss veterinary authorities, susceptible animals which graze near the border are regularly vaccinated.

63. Ring vaccination is sometimes employed, but not always. When it is, all susceptible animals are vaccinated within a radius of ten kilometers from the outbreak. The State pays the cost of the vaccine, but only in a few departments is Ring vaccination actually compulsory. It is however generally accepted, and indeed welcomed, by the farmers.

64. But ninety per cent. of the vaccination that is carried out in France is neither Frontier nor Ring nor instigated or enforced by the Government. It is done at the instance of the farmers themselves, often through co-operative organisations established for the purpose and encouraged by the supply of State-subsidised vaccine. If a farmer undertakes to have all his animals vaccinated, the vaccine is supplied free. But there is not yet enough vaccine to satisfy all demands, and vaccination is usually confined to the more valuable cows and pedigree breeding stock. In 1952 six million animals were vaccinated out of a total susceptible population of 31 million, but in some departments the proportion is much higher: in one or two the percentage of herds in which some vaccination is done is put at over ninety. Trivalent vaccine is sometimes used, but the usual practice is to try to get

protection against the three main types by injecting a bivalent and a monovalent vaccine. This is said to give satisfactory results if done twice a year, provided that a new variant does not appear unexpectedly, as it did in 1952. One witness said that in that year prepared vaccine to the value of £3,000,000 became useless for this reason. But other witnesses said that the effects of the disease were less serious in vaccinated animals, even though the vaccine used had not been specific to the new variant; and the same was said of vaccination which failed to confer immunity not because of the appearance of a new variant but because it was not repeated often enough.

65. Vaccines are manufactured at three privately-owned plants which are supervised by the French Government. A fourth is being built. The largest plant is at the Foot-and-Mouth Disease Institute at Lyons. The Institute produces monovalent vaccines (O_2, A_5 and C) and bivalent vaccines (O_2/A_5 and A_5/C) but its ambition is to make a satisfactory trivalent. The present rate of production is one million doses a year, but it is hoped by a change of method to increase this to two million doses a month.

Belgium

(Cattle—2 million; sheep—200,000; pigs—1 million. Number of outbreaks 1951/52—59,000.)

66. Frontier and Ring vaccination are by law compulsory in Belgium, and free vaccine is provided for the purpose by the Government. All the cattle and sheep in those areas have to be vaccinated, the pigs also if enough vaccine is available. In addition to these compulsory measures any farmer may arrange for vaccination at any time if supplies of vaccine are sufficient, and owners of pedigree and attested animals usually do so.

67. Since 1946 the Belgian Government have endeavoured to maintain a zone of immunised animals along its frontiers to a depth of 4-5 kilometers; if more vaccine were available the depth of the belt would be increased. For Ring vaccination the radius of the area varies from $\frac{1}{2}$ to 1 kilometer according to the topography of the locality. The Belgian authorities would like to extend the radius of the ring to 5 kilometers; they said that outbreaks of the disease had occurred just outside areas in which Ring vaccination had been carried out. There was always the danger that infection might be carried through the ring by such means as vehicles. Even within the ring there were occasional outbreaks before the vaccines had had time to produce immunity, which took seven to fourteen days. The number of secondary outbreaks occurring at the time of our visit was said to be small, and this was attributed chiefly to vaccination, although it was admitted that the residual immunity after the epidemic of 1951-52 might be partly responsible. But the general opinion was that Ring vaccination was useful in confining the spread of the disease.

68. The vaccine used in Belgium is produced at the State Veterinary Research Laboratory near Brussels. Trivalent (A/O/C) vaccine is now being manufactured. It is admittedly less reliable than the monovalent and bivalent vaccines, but the need to give some protection in advance against all three main types of the virus is regarded as paramount. On all the three farms we visited in Belgium there had been outbreaks in cattle vaccinated less than six months earlier with monovalent vaccine. In two cases these were caused by a different type of virus; in the third the failure to immunise the affected cattle was attributed to the use of a bottle of vaccine that had been left in the open all night, for none

of the other vaccinated cattle contracted the disease. The trivalent vaccine had been introduced six months before we visited Belgium, and 600,000 cattle had been vaccinated with it. So far as was known there had been only three outbreaks among them, and in all cases the disease was mild. It was thought that the trivalent vaccine conferred a measure of resistance to the within-type variants which was sufficient to prevent the recurrence of a disaster like that of 1951/52. The duration of the immunity conferred by trivalent vaccine is not yet known. Vaccines were thought to confer as good an immunity on pigs as on other animals although cases were known where piglets had died after vaccination.

Argentina

(Cattle—41 million; sheep—51 million; pigs—3 million. Number of outbreaks 1951/52—not known.)

69. No statistics are available about the incidence of the disease. Patagonia is said to be free from it, but over the rest of the country epidemics are officially stated to occur annually. Vaccination is voluntary in Argentina and is extensively practised; many farmers inject the vaccine themselves. (In all the other countries we visited the injection is done by veterinary surgeons.) In one area the Government have recently embarked on a plan of compulsory vaccination at four-monthly intervals with the dual object of testing the effectiveness of vaccines and of serving as a pilot scheme for the introduction of compulsory vaccination on a wider scale. The plan was put into operation about four months before our visit and was said to have given good results so far, except that the veterinary authorities had found that it was impossible to immunise effectively animals below the age of six months.

70. The Argentinian Ministry of Agriculture and Livestock have great faith in vaccination as a means of combating the disease. They say that it has already reduced the incidence in their country, and they hope that in a few years enough vaccine will be produced for the vaccination of all cattle, sheep and pigs to be made compulsory. Certain farmers in the province of Buenos Aires were said to have been vaccinating at four-monthly intervals for four years and no outbreaks of the disease had occurred on their farms during that time. Previously their herds had been frequently infected. But to vaccinate all the cattle in the country (not counting sheep and pigs) three times a year would need an annual production of some 120 million doses of vaccine, and at the time of our visit it was only fifteen million. Few farmers therefore can yet vaccinate as often as that.

71. We were not able to visit the district where vaccination was already compulsory, but thanks to the good offices of the Argentine Government we went to seven important ranches elsewhere and discussed the question with the managers. We found some diversity both of practice and of opinion. On one point there was general agreement: the difficulty of immunising young stock. It seems to be a common occurrence, whatever precautions are taken, for calves to contract the disease immediately after weaning. Some managers said that most of their cattle had it before the age of fifteen months, and that it was virtually impossible to immunise them earlier. Some do not vaccinate at all; they do not think the expense is justified. Of the many who do practise vaccination (though not, among those we saw, as often as three times a year) the general opinion seemed to be that it rarely confers complete protection by itself. On some ranches

outbreaks occur every year, although regular vaccination is practised; indeed we ourselves saw many vaccinated animals that were suffering from the disease or had recently recovered from it. But even so vaccination is generally thought to be worth while; it is said to reduce the severity of the disease and to give protection eventually in cattle that have suffered several attacks. One manager said that some of his animals had had three attacks in three years but afterwards seemed to be successfully protected by repeated vaccination.

72. Vaccine production in Argentina is in the hands of private firms. Their laboratories are licensed and their plant has to be approved by the Government National Institute of Foot-and-Mouth Disease. The Institute tests samples of vaccines from each laboratory approximately every twenty-five days. We were told that about 30 per cent. of the batches of vaccines tested failed to reach the required standards of innocuity, sterility and potency. When a batch of vaccine fails the tests, the rest of the batch at the laboratory is destroyed, but some of the unsatisfactory vaccine may have been sold for use in the field before the testing took place. Special tests are carried out when complaints are received from farmers that a vaccine has failed. Licences to produce vaccine have been withdrawn from some firms because their vaccines were unsatisfactory. Failures were said to be rare when vaccines from the larger laboratories (which produce most of the supply) were used. The failures that did occur among vaccines produced by them were attributed to faulty injection or to animals being already infected before vaccination.

73. We visited the National Institute of Foot-and-Mouth Disease and the laboratories of two of the most important producing firms. Monovalent A, O and C vaccines are manufactured and mixed to give a trivalent one. Most of the vaccine in Argentina is manufactured for intradermic injection; that is for injection into the skin itself. This method requires considerably less vaccine but the dose is more concentrated. At one of the laboratories we visited we were told that they preferred to manufacture vaccine for subcutaneous injection, that is injection beneath the skin, because some failures are inevitable when the intradermic method is used. (Injections are given subcutaneously in all the European countries we visited where vaccination is carried out.) At this laboratory we were also told that the best results with their vaccine were obtained in cattle; the vaccine was not so successful with sheep and considerably less so with pigs. In cattle it is said to produce immunity in fifteen days and to maintain it for four months.

Stamping-out and vaccination in combination

Switzerland

(Cattle—1,700,000; sheep—200,000; pigs—1 million. Number of outbreaks 1951/52—428.)

74. As we have seen, foot-and-mouth disease is infrequent in Switzerland (the recent average annual number of outbreaks is about ten), and rigorous stamping-out is the staple policy. But Frontier and Ring vaccination are also practised. They are compulsory under the Federal law, and the expense is shared by the Federal and Cantonal authorities. Vaccination, we were told, was added as the final safeguard, a safeguard which the Swiss thought to be justified under the conditions in their country. Although within the frontier belts and ring zones all susceptible animals are vaccinated, some doubt was expressed about the effectiveness of vaccine as a protection for sheep and pigs, and it was said that if there were large numbers of sheep in the country the vaccination policy might have to be modified.

75. Frontier vaccination was first practised in 1943 and is carried out in collaboration with the Italian, French and German veterinary authorities. It is done every Spring, and the immunity it gives is said to last at least 8 months. It is also done at other times if the disease on the other side of the frontier becomes threatening. The zones of vaccination do not cover the whole length of the frontiers, but only those places where animals graze near the border and are likely to have contact with animals in the neighbouring countries. The depth of the vaccination belt varies from half a kilometer to twelve kilometers according to the terrain. In the Canton of Geneva all the susceptible animals are regularly vaccinated because it is particularly exposed to infection. Frontier vaccination is said to have been of great value in preventing the introduction of the disease into Switzerland ; the annual cost of carrying it out is about £16,000.

76. Ring vaccination is carried out when outbreaks occur. All the susceptible animals on the infected farm are immediately slaughtered, and all the susceptible animals within the ring are vaccinated. The radius of the ring varies from half a kilometer to ten kilometers ; the size depends on the terrain and the extent of the movement of animals from the infected farm before the outbreak was discovered. When an infected animal has been through a market, all susceptible animals that were in the market with it or subsequently passed through are vaccinated ; and so are all susceptible animals on the farms to which the animals from the market have been sent. Vaccination in a ring sometimes means vaccinating as many as 15,000 animals. The Swiss assert that, as a result of Ring vaccination, subsequent outbreaks are now exceptional, whereas there used to be from two to four to each primary. Now they occur only when there has not been time enough for the vaccine to produce immunity. The adoption of vaccination is said to be responsible, at least in part, for the fact that the country's loss due to foot-and-mouth disease in the European pandemic of 1951-52 was only $3\frac{1}{2}$ million francs as compared with 30 million in that of 1938-39. Of 300,000 cattle vaccinated in 1952 only two contracted the disease. Our witnesses recognised, however, that the reduction in the number of secondary outbreaks might be partly attributable to the increased speed with which the slaughter of infected animals is now carried out, to the more effective disinfection now insisted on and to the more rigorous application of the restrictions on the movements of animals after an outbreak has occurred.

77. The Swiss use various bivalent vaccines e.g. O/A, O/A_5, O/C and A_5/C. They do not think trivalent vaccines are satisfactory. All the vaccines used are produced at the Federal Government Vaccine Institute at Basle. The Institute is capable of producing enough doses to vaccinate all the cattle once a year, but production is not carried out on this scale. Two reasons were given for this. One was that vaccine prepared in advance of an outbreak would not guarantee protection against the disease if a variant of the virus appeared ; the other that to vaccinate all cattle might give farmers a false sense of security and lead to slackness in reporting. The virus is typed within a day or two at the Institute, and if it is found that a new vaccine is needed it can be produced untested in about two weeks.

Denmark

(Cattle—3 million ; sheep—50,000 ; pigs—3 million. Number of outbreaks 1951/52—28,000.)

78. Stamping-out used to be practised in Denmark, but had to be abandoned during the epidemic of 1925-26, when three-quarters of the herds in the country were affected. Since then stamping-out has taken place intermittently, but it has always been found impossible to continue it when

the disease is serious in Germany, because of the large number of outbreaks that ensue in Denmark. Our witnesses did not think it would be possible to resume stamping-out as a settled policy unless Germany got the disease under control.

79. The vaccination of animals on an infected farm and those within a ring around the farm has recently been made compulsory. The radius of the ring is two kilometers. Although the disease sometimes jumps the ring, our Danish witnesses were convinced that Ring vaccination was worth while. They said that, even if some animals in the ring became infected before immunity had developed, vaccination at least mitigated the effects of the disease. Vaccination is also compulsory on farms outside the ring which deliver milk to the creamery supplied by the infected farm. The average supply area of a creamery has a radius of 10 kilometers. Even when there has been no outbreak, compulsory vaccination may be ordered of all animals supplying a particular creamery or all animals within a zone around a market. When this is done the vaccination is ordered and paid for by the creamery or market authorities as the case may be. The Government have power to order compulsory vaccination anywhere at public expense whenever there is a threat of the disease entering the country. But no attempt is made to maintain an immune animal population by universal vaccination ; it is considered that this would be ineffective and wasteful because there are so many different varieties of the virus. Cattle, sheep and goats are vaccinated, but it has been found difficult to immunise calves effectively. Pigs are not vaccinated because the results have been unsatisfactory. It takes twelve to fourteen days for vaccination to produce immunity ; the duration of the immunity is variously estimated ; that conferred by the monovalent A_5 is put at 12 to 18 months and that by the bivalent A_5/C at eight. For young animals the immunity would be of shorter duration.

80. Vaccine is produced at the Government Veterinary Institute for Virus Research on the island of Lindholm. The vaccines now ordinarily manufactured are the bivalents O/A and A_5/C. Some vaccine is stored, but it is thought better to rely mainly on stores of virus, because a new variant might appear against which the vaccine would be useless. Moreover it is thought that vaccine may become infective if kept for more than two years ; instances were quoted where vaccine stored too long had infected the animals inoculated with it. The policy is to be prepared to meet whatever attack may come, when it comes. In 1951 it had been possible to produce a fully tested vaccine against the new variant in five weeks.

Sweden

(Cattle—2½ million ; sheep—250,000 ; pigs—1½ million. Number of outbreaks 1951/52—833.)

81. Sweden relies in the main on rigorous stamping-out, but there are certain " listed " herds of exceptional value, and it has long been the practice, if an outbreak occurs in one of them, to isolate the herd instead of slaughtering it. Vaccination is now compulsory in two classes of case. One is the vaccination of all cattle in a ring of two kilometers radius round an outbreak. The other is the vaccination of the " listed " herds when the country is threatened by the disease. Vaccinated cattle are not revaccinated as a routine. This is only done if the threat still exists: vaccination is treated as a defence against an emergency when one occurs. Sheep and pigs are not vaccinated. Vaccine is obtained from Denmark. Samples of the virus recovered from outbreaks are sent to that country for the type to be determined, but Ring vaccination has to be carried out before the results of the typing are known.

The type can however be anticipated with some confidence, and the Swedish veterinarians thought that Ring vaccination, if done in time, prevented the spread of the disease. They thought that calves could be satisfactorily immunised. The monovalent A_5 vaccine was mainly used during the epidemic of 1951-52 but also the bivalents A/O and A_5/C. These vaccines were said to produce in two or three weeks an immunity which lasted for about eight months, but the duration of immunity is longer for older animals and shorter for young ones.

82. The Swedish veterinarians told us that the usefulness of vaccination could be judged by comparing the devastation caused by the disease in 1938-40 with the comparatively small losses in the epidemic of 1951-52.

Finland

(Cattle—1½ million ; sheep—1 million ; pigs—½ million. Number of outbreaks—None in 1951/52 but 120 in 1952-53.)

83. Except in 1939-40, when there were about 5,000 outbreaks, the disease has occurred only sporadically in Finland. The general control policy is stamping-out combined with rigorous disinfection and quarantine of infected farms. Agricultural markets and shows and movements and gatherings of people in the neighbourhood of outbreaks are prohibited or limited. In 1952 this policy was supplemented, in the case of sporadic outbreaks, by partial Ring vaccination ; and in one heavily infected district a special technique was adopted. In the outskirts of the district, infected herds were slaughtered and the rest vaccinated. Within the district infected herds were not slaughtered but were subjected to strict isolation. The healthy herds within the district and in a large surrounding area were systematically vaccinated. The disease was stamped out in two months, during which time about 4,500 animals were slaughtered.

Holland

(Cattle—3 million ; sheep—400,000 ; pigs—2 million. Number of outbreaks 1951/52—28,000.)

84. Vaccination was introduced in Holland in 1947. There was no Frontier or Ring vaccination, but any farmer who wished could have it done by his own veterinary surgeon. This opportunity was freely taken, and before long eighty to ninety per cent. of the farmers were vaccinating their cattle. But they did not all keep it up, and by the time the epidemic of 1951–52 attacked the country the number had fallen considerably. The epidemic led to a widespread revival of vaccination, and this has been maintained. Vaccination is still nominally voluntary, but an element of indirect compulsion has been introduced by a law passed in February, 1953, which prohibits the movement away from any farm of any cattle (other than calves) unless the herd was vaccinated not more than six months or less than two weeks before.

85. During the epidemic (in July, 1952) Holland adopted stamping-out as a supplement to vaccination. If the herd in which an outbreak occurs has been vaccinated within six months, only the infected animals are slaughtered ; otherwise the whole herd is. The official Dutch view is that vaccination every six months is necessary to secure immunity. But a representative of the State Veterinary Service from whom we took evidence said that it was difficult to immunise young animals effectively, and he did not think that the disease would ever be eradicated from Holland by vaccination. The view expressed to us at the Veterinary Research Institute at Amsterdam was that, although young animals were difficult to protect,

vaccination rarely failed to give some immunity and that the disease could be eradicated by vaccination (together with stamping-out) if there were co-operation between Holland, Belgium and Germany.

86. All the vaccines used in Holland are produced at the Institute. Monovalent vaccines of the A, O and C types are manufactured and they are mixed by the veterinary surgeons before injection. The Dutch said that their A vaccine is effective against the variant A_5. The Dutch vaccine takes 14 days to produce immunity and on average the immunity is said to last for eight months; but the period is longer for old animals and shorter for young ones. They keep large stocks of A, O and C vaccine, and said that if a new virus appeared it would be possible to produce a vaccine from it fully-tested in one month or untested in a fortnight. The visits we paid to farms in Holland fully bore out what we had been told about the strong faith that farmers have in the efficacy of vaccination, except a small number who have conscientious objections to it.

Mexico

87. The disease appeared in Mexico late in 1946. It spread very quickly and threatened to cross the United States frontier. A joint United States-Mexican Commission was set up to combat this. They decided to attempt eradication by slaughtering all infected animals, including those that had recovered from the disease, and all contacts, together with the disinfection of infected premises and the maintenance of quarantine lines. This last was an immense undertaking. The quarantine area in Mexico at one time covered over 200,000 square miles, and a quarantine patrol was also maintained along the 1,900 miles of the border from California to the Gulf of Mexico. In the 1948 Report of the Special Sub-committee to the Committee on Appropriations of the United States Senate it is said that by November, 1947, nearly one million animals had been slaughtered. The owners were compensated. But the plan of campaign had to be changed in two ways: the slaughter of recovered animals was stopped and recourse was had to vaccination. The reasons for this change of policy are given in the following extracts from the Sub-committee's Report.

> "The methods of quarantine, slaughter, burial and disinfection were continued through November of 1947 on a scale that required at its peak the slaughter of 50,000 animals a week. In spite of such tremendous efforts, it was found that the quarantine lines were not being maintained. The strain of the economic shock of such wholesale slaughter forced the Mexican Government to request a change in the methods of the program. An appraisal indicated the continuation of the slaughter program would mean the destruction of 4,500,000 cattle and a similar number of swine, sheep and goats. The livestock population of Mexico is estimated to be 12,000,000 cattle and calves, and 16,000,000 swine, sheep and goats.
>
> On November 26, 1947, the methods of the program were changed to provide for the creation of buffer zones between the quarantine lines and the infected area, and to provide within the buffer zones for extensive inspections to locate infected animals, for the slaughtering of infected and exposed animals, and for the vaccination of healthy animals to build up their resistance to the disease. It was intended that these same procedures would be applied throughout the infected area by enlargement of the buffer zones as rapidly as possible. This began a program in many respects new to both countries, and in its magnitude was beyond the experience of any country in the world."

It was not until nearly four years more had passed that the disease was eradicated in September, 1951. During that time 60 million doses of vaccine

had been injected, and a further $75 million spent in addition to the $35 million that the first phase of the campaign had cost. During the second phase the authorities allowed animals that had recovered to remain on the ranches, but continued to slaughter every infected animal and every exposed unvaccinated animal that was found. These amounted to only 49,000 animals, compared with over a million slaughtered in the twelve months of the first phase. Although it is impossible to gauge the extent to which the epidemic had been overcome by slaughter at the time vaccination was begun, it seems clear that vaccination was of value in this campaign.

International action

88. We have described in this Chapter the action now being taken in various countries to check the ravages of foot-and-mouth disease. But the disease does not respect national frontiers; the campaign against it is handicapped if it is waged piecemeal, and each country acts as though it were a self-contained unit. International collaboration is essential for the effective control of animal disease.

89. This truth first received practical recognition in 1924, when the International Epizootics Office (O.I.E.) was established in Paris with the support of 53 countries, including the United Kingdom. Its functions, in general terms, are to arrange for the exchange of information, to institute investigation and to further co-ordination of action as regards transmissible diseases of livestock. The members are mainly the directors of the veterinary services of the adhering countries. Meetings are held at least once a year, and special attention has been given to foot-and-mouth disease. After the war, international measures for the control of foot-and-mouth disease became the concern of two other bodies also—the Food and Agriculture Organisation of the United Nations (F.A.O.) and the Organisation for European Economic Co-operation (O.E.E.C.); and the distinction between the functions of the three international bodies working in this field seems to have lacked something in clarity. Finally, at a conference held in Copenhagen in September, 1952, thirteen Western European countries pledged themselves to take steps to have adequate supplies of vaccine available to meet future epidemics, and proposed the formation of an International Commission to co-ordinate the activities of the member countries and to give help and advice to those who needed it. The objects of the Commission, and the obligations undertaken by its members, are briefly as follows. The member Governments have undertaken to control the disease, with a view to its ultimate eradication, by instituting suitable quarantine and sanitary measures and by one or more of the following methods:

(*a*) a slaughter policy;

(*b*) slaughter together with vaccination;

(*c*) maintenance of a totally immune cattle population by vaccination;

(*d*) vaccination in zones surrounding outbreaks.

The constitution of the Commission is set out in Appendix XIV. It provides that members shall:

(i) give immediate notification to the Commission of any outbreak of the disease and its extent;

(ii) arrange for immediate typing of the virus and notify the Commission of the result;

(iii) collaborate and assist each other in the provision of vaccine and virus;

and that the Commission shall:

(i) disseminate as quickly as possible the information received about outbreaks, their extent and the type of virus ;

(ii) arrange facilities for the typing of the virus ;

(iii) arrange for the production and storage of adequate supplies of vaccine ;

(iv) provide technical advice ; and

(v) stimulate research work.

We understand that the F.A.O. are trying to promote similar bodies in other parts of the world.

90. The constitution of the Commission was formally approved by the Seventh Conference of the Food and Agriculture Organisation on the 11th December, 1953 (with France, Spain, Greece and Switzerland abstaining). But the constitution does not enter into force until six member nations of the Food and Agriculture Organisation or of the O.I.E. have formally deposited notification of acceptance. At the time of writing this Report only five countries have formally accepted ; the United Kingdom, Denmark, the Republic of Ireland, Norway and Yugoslavia. The Commission has therefore not yet been established. Over eighteen months have passed since the thirteen Western European countries pledged themselves to take concerted action against foot-and-mouth disease, and we feel bound to record our great disappointment at the slow progress that has been made. We hope that the British Government who have strongly supported the movement throughout, will take any action in their power with a view to resuscitating the interest of other European Governments in what promised to be the most encouraging development in the fight against foot-and-mouth disease.

CHAPTER IV

POLICY FOR DEALING WITH THE DISEASE IN GREAT BRITAIN

91. Our Terms of Reference require us to advise whether any changes should be made in the " policy and arrangements " for dealing with foot-and-mouth disease in Great Britain. In this Chapter we shall be concerned with " policy " only, leaving " arrangements " for a later one. It will be clear from what we have already said that the determination of policy must depend on the comparative merits of stamping-out and vaccination applied to the conditions prevailing in this country. The first question we shall have to consider is whether vaccination could take the place of stamping-out. If we find that it could not, we shall have to turn to the question whether vaccination could usefully be combined with the present system. In summarising the evidence given to us about policy it will not be possible to disentangle these two questions. But when we come to weigh the evidence and state our conclusions, we shall treat them separately.

Vaccination as a substitute for stamping-out

92. Among the many associations we heard representing agricultural interests, veterinary science and local authorities, opinion was unanimous that stamping-out must be continued. The following are extracts from the memoranda submitted by some of them:

The Royal College of Veterinary Surgeons

" In the light of present scientific knowledge and conditions prevailing on the Continent of Europe it is the confirmed opinion of this Royal

College that the present policy of the Animal Health Division (of the Ministry of Agriculture and Fisheries) in the control of foot-and-mouth disease within Great Britain consisting of

(i) restriction of the movement of animals in the vicinity of outbreaks of the disease, together with

(ii) immediate destruction of all infected animals and all "in contact" animals

is both proper and as effective as is at present possible. This opinion is subject to two reservations hereafter referred to, namely

(*a*) the urgent necessity of further scientific research to provide alternative or improved methods of control;

(*b*) improvements in the administration and scope of the policy."

The National Farmers' Union of England and Wales

"The Union has considered fully the present slaughter policy and also the question of changing to a vaccination policy. It has taken into account work being done at Pirbright and the methods used in other countries. It is essential that the closest touch should be maintained with work being done overseas as well as intensifying research into the manufacture of vaccines in England. On the evidence available we are of the opinion that it would be a mistake to depart from the slaughter policy as the main instrument of control."

The Royal Agricultural Society of England

"The R.A.S.E. would oppose strongly any change in the present slaughter-cum-compensation policy which caused the smallest danger that might make it possible for the disease to become endemic in these islands. It is most difficult to visualise how such 100 per cent. security can be obtained by vaccination in the present state of our scientific knowledge as:

(*a*) Foot-and-Mouth disease is caused by three or more types each needing its own special vaccine and each type having a liability to variations sufficient to need a new vaccine, the need only becoming apparent through the failure of the one in use;

(*b*) any immunity is only assured for a comparatively short period;

(*c*) finally that 100 per cent. efficiency of any veterinary biological product is almost, if not quite, impossible to guarantee. It is obvious that any policy of vaccination, instead of our present policy or a combination of the two, would open up many sources of danger of causing the disease to be endemic."

The Milk Marketing Board (of England and Wales)

"The Board accepts the fact that highly infectious strains of foot-and-mouth virus are a serious menace to the health and production of the nation's herds of cattle and that the risk of infection from the Continent and other sources is always present; in these circumstances it believes that the Ministry of Agriculture's policy of slaughter on farms on which infection is found is completely justified and that there is no alternative."

The National Cattle Breeders' Association

"We believe that the complete prevention of introduction of infection is not possible at present. It is, therefore, essential once this statement is accepted that the destruction of introduced virus must take place as soon as possible. Since the virus only multiplies in the infected animal, to achieve its destruction slaughter of the animal and its contacts is the only solution."

The National Union of Agricultural Workers

"In our view the balance of evidence weighs down heavily in favour of the present policy. No one has yet been able to show a better alternative to slaughter and compensation in the control of the disease."

The Royal Highland and Agricultural Society of Scotland

"In the Society's view, having regard to this country's geographical position and other considerations peculiar to Great Britain as compared with continental countries, there is no alternative to the present slaughter policy. . . . The immunisation of animals by vaccination is deprecated, not only because of the heavy costs involved, but also in view of the various types of virus encountered and the disastrous effects which a vaccination policy would undoubtedly have on British export trade in pedigree stock."

The National Farmers' Union of Scotland

"On the assumption that everything practicable is being done and will continue to be done :—

(*a*) to discover a preventive agent against the disease,

(*b*) to prevent, in the interval, the spread of the disease to this country, and

(*c*) to confine outbreaks in the United Kingdom to the area or areas of primary infection,

the Union is in favour of a slaughter policy being followed. In this connection the Union is impressed by the exceptional infectivity of foot-and-mouth; by the fact that an animal may be a carrier of the disease though showing no symptoms of it, and that the channels by which the virus may be conveyed are not all controllable (e.g. birds, vermin, ground game). Having regard to these various considerations and the alarming possibility of the disease becoming endemic or even gaining a firm hold in this country, the Union considers that there can be no alternative to a slaughter policy until such time as a vaccine (or vaccines) is discovered which will afford full protection against the spread of the disease, be so accepted by overseas countries importing livestock from the United Kingdom, and be in general use."

The British Veterinary Association

"The slaughter policy is designed to do just what is required, namely to prevent the propagation and spread of the virus once infection has been introduced. From the aesthetic point of view it is not acceptable to those who do not appreciate the amount of animal suffering which would otherwise occur. It is the ideal means of preventing the disease becoming endemic in Britain."

Other associations expressing similar views were:

The Royal Welsh Agricultural Society.

The Aberdeen and District Milk Marketing Board.

The North of Scotland Milk Marketing Board.

The Blackface Sheep Breeders' Association.

The National Pig Breeders' Association.

The Scottish Pig Producers' Association.

The County Councils' Association of England.

The Counties of Cities Association of Scotland.

The Association of County Councils in Scotland.

93. Individual witnesses (farmers and scientists) were of the same opinion almost unanimously. One farmer who had been a strong opponent of slaughter told us that he had been converted to the policy after seeing the agony suffered by his own animals when they were attacked by the disease. Lord Iveagh, who had the misfortune to lose herds of pedigree cattle in both 1926 and 1952, said:

> "The slaughter policy involves, of course, very grievous loss to the pedigree breeder which cannot be compensated for since he loses years of work in breeding and much of his future hopes, and in losing his best females and proven bulls his work is largely undone. Nevertheless, I do not suggest that this policy can be abandoned in the present state of our knowledge. What I hope for is that with increased knowledge of vaccines, serums and their application, our most valuable pedigree stock might be protected as well as cattle belonging to our Artificial Insemination Centres and Research Institutes."

Finally, Sir Thomas Dalling, Chief Veterinary Consultant to the Food and Agriculture Organisation of the United Nations, who has world-wide experience of foot-and-mouth disease:

> "It is perfectly clear to me that, where practicable, the 'stamping-out' or slaughter policy is to be preferred to the others [i.e. vaccination alone or slaughter with ring vaccination]. By such a policy, carried out as in Great Britain, it can be accepted that, following the removal of all restrictions, the country is entirely free for the time being of foot-and-mouth disease infection. This is a state to be aimed at, for I am very doubtful that, with any other policy, it is possible to ensure complete freedom from the infection at any time. In further support of this view, I may quote from the remarks made to me by Veterinary Directors in several European countries, who state freely that the only sure method of eradicating (not controlling) the infection is by a rigorous slaughter policy . . . When foot-and-mouth disease gains a foothold in a country to such an extent that it becomes uneconomical to slaughter, a vaccination policy has to be considered. Further, in countries which are exposed to the infection crossing their frontiers at many points at about the same time, vaccination becomes almost an essential policy."

94. Our evidence from British witnesses about the need to continue stamping-out in present circumstances was therefore in substance unanimous. But it differed in emphasis: it ranged from those who called stamping-out an "ideal" policy, and would have nothing to do with vaccination, to those who regarded it as a deplorable necessity and urged that the practicability of controlling the disease in some other way should be continuously and energetically explored. One or two witnesses went further, and contended that it might have already been possible to dispense with stamping-out if the Ministry had been more active in examining the possibilities of vaccination or had been willing to test the claims made on behalf of certain other preventives or "cures". We return to this subject in paragraph 131.

95. During our visits abroad we took the opportunity of obtaining from foreign experts not only information about the working of the vaccination policy in their countries but also opinions about what was the proper policy for Britain. We found that in countries where the disease is endemic, and vaccination alone is practised, vaccination is ordinarily not regarded as a possible means of eradicating the disease or as a preferable alternative to stamping-out; its purpose is rather to reduce the incidence of the disease to a point where stamping-out becomes possible. In Argentina for instance the Ministry of Agriculture and Livestock said that this was their aim. At

the Danish Government Veterinary Institute for Virus Research we were told that the adoption of stamping-out would be recommended if the time ever came when there were only a few cases in Germany and there had been none in Denmark for some years. The experts there thought it would be unwise for Great Britain to substitute vaccination for stamping-out; apart from the difficulties that would be caused by the large number of sheep and pigs, the expense would not be justified in a country where the incidence of the disease was so low; there would moreover be the danger that initial outbreaks might be obscured by vaccination. Holland, as we have seen, has already supplemented vaccination by stamping-out. The representatives of the Dutch veterinary association thought that to supplement stamping-out by vaccination would be a suitable policy for Great Britain, although they agreed that the large number of sheep would present a problem. The Belgian Minister of Agriculture expressed the view that if ever the incidence of the disease was reduced to very small dimensions in his country it would then be best to slaughter. At the Pan-American Foot-and-Mouth Disease Centre at Rio de Janeiro, we were told that vaccination was practised in Colombia with the object of reducing the incidence of the disease to such a level that it would become economic to slaughter. The Director of the Centre was emphatic that slaughter ought to be continued in Great Britain. The proof of its value was that Great Britain remained remarkably free from the disease, considering our vulnerability to infection. He felt no doubt that it would be wrong for any country that followed the stamping-out policy to introduce any form of vaccination so long as slaughter was economically possible. In Norway, where stamping-out is the policy, we learnt that there had been pressure from farmers for vaccination during the last series of outbreaks. The Government Veterinary Directorate had allayed this by pointing to the small number of outbreaks in the country, the expense of vaccination and its ineffectiveness when variants appeared. The Government Directorate said emphatically that they had no intention of adopting a vaccination policy; they believed it to be dangerous on account of the risk that vaccinated animals might become unrecognised carriers of disease.

96. We wish to make it clear at the outset that we are not among those who regard stamping-out with complacency. We sympathise with the widely expressed view that it is a crude and primitive way of dealing with a disease. We know what a harrowing duty it is for the officers of the Ministry who have to carry it out. We recognise the mental anguish it may cause to those who suffer its consequences, and the shattering disaster, not computable in terms of money, that it may bring to a farmer who has to see the work of a lifetime destroyed in a day. Nevertheless we have no doubt whatever that in present circumstances it must continue.

97. For reasons we have already explained, we are convinced that it is impossible to exaggerate the importance of taking instant action to prevent the propagation of the virus. Both at home and abroad we found our witnesses unanimous that the only sure way of doing this is to slaughter the animal; the evidence we have quoted shows that most countries—perhaps all—would have recourse to this method if the incidence of the disease could be reduced to a point low enough to make it practicable. If we take as our postulate—as we think we are bound to do—that once an animal gets the disease there is no other safe course, it follows that stamping-out could only be completely discontinued in this country if all susceptible animals in it were made permanently immune. The only promising way of doing this that science has discovered is repeated vaccination. Since the immunity it gives cannot be relied on to be completely effective for more than four

months (see paragraph 100 (c)) this would mean the vaccination of some ten million cattle, twenty-two million sheep and four million pigs three times a year.

98. This gigantic operation is manifestly impracticable. But we have thought it right to consider whether such a system of universal vaccination would be worth while if the practical difficulties could be overcome. The Ministry of Agriculture have supplied us with estimates of the cost, based on various assumptions, and have compared them with the cost of the present stamping-out policy. (Their memorandum is printed as Appendix XV.) According to these calculations the annual cost of universal vaccination three times a year would be not less than £24 million and might be as much as £56 million, according to the assumptions made. If cattle only were vaccinated, in the hope of confining stamping-out to sheep and pigs, the corresponding figures would be £10 million and £23 million. The cost of stamping-out in 1952 was £2½ million, and that year was the worst of recent times, when the number of animals slaughtered was five times as great as the average for the last twenty-five years. These figures have of course an element of the conjectural, and must be taken with reserve. They tend to make the contrast too sharp. On the one side the manufacture of vaccine on a large scale might be expected to reduce the cost per dose ; on the other side the figure given for the cost of stamping-out does not include the indirect losses of farmers. But even when all reasonable allowance is made for these factors it seems clear that the annual cost of vaccination on this scale, assuming it to be practicable, would be many times as great as the annual cost of stamping-out. As an insurance premium against the infection of something less than 0·06 per cent. of the cattle in the country—for that is the average annual percentage infected or exposed to infection during the past twenty-five years—it would be preposterously disproportionate to the risk. If the Ministry's lowest estimate of £10 million for the vaccination of cattle only is taken, and applied to the figure of 0·06 per cent., it would mean that the cost of keeping alive by vaccination each beast that would otherwise be slaughtered because of infection or exposure to infection was £1,666. And there would be no certainty that we should get what we were paying for, since there would still remain the difficulty of immunising young stock, the multiplicity of virus strains and the danger of new variants.

99. We know how dangerous it is to be dogmatic about the limitations of possible scientific discovery. We recognise that there may be advances that would make the picture quite different. (An account of the progress made in the manufacture of vaccines is given in Appendix XVI.) But if we look at the circumstances of today, and of the immediate future so far as they are foreseeable, we must conclude that any idea that it would be possible to do away with stamping-out by making the whole susceptible animal population—or even all cattle—immune by vaccination is in the realm of fantasy. Nor indeed did any witness suggest that it could be done. But as there seems to be much popular interest in this subject, and some common misconception, we have thought it worth while to examine the implications of such an undertaking.

Vaccination in combination with stamping-out

Preliminary considerations

100. We must now turn to the much more important question whether vaccination might be used as an adjunct to stamping-out in this country. We must first examine certain fundamental questions.

(a) *To what extent is effective immunity given by vaccines*? There is general agreement that monovalent and bivalent vaccines give satisfactory results in protecting the vaccinated animal for a time against

the varieties of the virus used in their manufacture. Among our expert witnesses no one even of those enthusiastic for vaccination claimed 100 per cent. protection for any vaccine, while of those who approached the subject with greater reserve one eminent witness said that monovalent vaccines were " reasonably good ", and another thought that the best possible vaccine would give 90 per cent. immunity. We think it may be accepted that in adult cattle, monovalent and bivalent vaccines, properly made, properly stored and properly administered, will give 90 per cent. protection: that is that on average nine animals out of every ten will resist for a time natural infection by the strain or strains of virus against which they have been vaccinated. About the effectiveness of trivalent vaccines there was some difference of opinion among our witnesses, but the great majority thought that they were not as satisfactory as the monovalent and bivalent types. Not only is it said that mixing vaccines shortens the period of immunity, but it has also been suggested in most countries that trivalent vaccines " block the immunity ": that is to say that the three different vaccines in a trivalent preparation interfere with one another and prevent each of them from being fully effective against its own particular type of virus. This view is not universally accepted. It is not held in Holland and Belgium for instance, but in those two countries the experiments with trivalent vaccines are in their early stages. About polyvalent vaccines (those in which more than three strains of virus are mixed) there was general agreement among our witnesses that these are not satisfactory. There is no evidence to show how far vaccines prepared from the three main types of virus (A, O and C) may be effective against their within-type variants except that we know that failures have occurred. Some of our witnesses have said that vaccination by one or more of the A, O and C vaccines has at any rate mitigated the effects of attacks by variants. The Dutch veterinarians would go no further than to say that their A vaccine is very effective against the variant A_5. It is possible that there exist in Europe variants which have not been typed. There is one theory that variants are now appearing because some A, O and C strains have to some extent been suppressed by vaccination, and another that variants are produced by changes taking place in the virus ; but neither has been proved.

(b) *How long is it before immunity is produced*? There was general agreement among our witnesses that it takes about fourteen days for vaccination to produce full immunity. We think this may be accepted.

(c) *How long does it last*? There was a sharp difference of opinion among our witnesses about the duration of the immunity conferred by vaccination. It may vary with the type of vaccine used. Some have said that immunity lasts for four months ; some have put it at eight months ; and in one country it was said to last for eight to eighteen months according to the type of vaccine used. Our conclusion is that it would not be safe to reckon on full immunity lasting more than four months.

(d) *Are the answers to these questions different for adult and young animals*? In only one of the countries we visited was it believed that vaccination could be effective in young stock. In all the others we were told either that it was difficult to vaccinate young stock effectively and that the immunity conferred was of short duration,

or that it was virtually impossible. In Denmark it was said that vaccination generally conferred no immunity in animals below the age of two years, and that, where it did, the immunity did not last long. In Argentina the Ministry of Agriculture and Livestock said that it was impossible to vaccinate animals below the age of six months effectively. As we have said elsewhere, some of the ranch managers in Argentina thought it was virtually impossible in the case of animals below the age of fifteen months. The evidence seems conclusive that young stock, particularly unweaned animals, are at least much more difficult to vaccinate effectively than adult stock.

(e) *Are bovine vaccines effective for sheep and pigs*? Here again there is a cleavage of opinion. The answers we received to the questions we put in foreign countries varied widely. Some said that bovine vaccines were effective for sheep and pigs, some that they were ineffective, and some that it was doubtful or that there was insufficient information to justify an opinion being expressed. The Governing Body of the Pirbright Institute said that, in experiments at Pirbright, bovine vaccines failed to produce satisfactory immunisation in pigs. They considered it unlikely that bovine vaccines would prove to be any more effective for the immunisation of sheep. It seems to us probable that vaccines specific to sheep and pigs will be found necessary for the effective vaccination of those animals. No experiments have yet been carried out at the Pirbright Research Institute on the production of such vaccines.

(f) *Can vaccination itself give animals the disease*? As we have said elsewhere, foot-and-mouth vaccines are made from the attenuated virus of the disease, and it seems not impossible that in some circumstances the virus in a vaccine might remain active, or become so with the passage of time, and infect the animal inoculated with it. In all the countries we visited, the vaccines are tested for innocuity, but the number of samples tested is necessarily small; the most sensitive method of testing (i.e. injection into the tongue) is not always used; and there must sometimes be a doubt about the susceptibility of the cattle used for testing. Such sample-testing cannot give a complete assurance of the innocuity of the vaccine, and in one country we were told that some old vaccine had infected some animals with the disease although the batch from which it was taken had passed tests for innocuity when it was originally prepared. But that was the only case we heard of, and there was a consensus of opinion among our expert witnesses that such an occurrence must be very rare. We do not think that the possible danger of giving an animal the disease is a serious argument against vaccination.

(g) *Are vaccinated animals liable to become unrecognised sources of infection*? It is widely believed that a vaccinated animal whose immunity is not complete may, on being exposed to infection, show only mild symptoms of the disease and be so little affected by the attack that it might remain undetected except under careful examination, and that such an animal might nevertheless excrete infective virus and so act as a source of infection. This " masked infection ", as it is usually called, is said to occur during the period when the immunity conferred by vaccination is beginning to wane. The explanation we have been given is that, with the passage of time, the antibodies in a vaccinated animal, while still capable of limiting

the effects of the disease if it is picked up, are nevertheless incapable of completely neutralising the infection. The danger of masked infection also occurs (*a*) in the interval between the injection of the vaccine and the production of maximum immunity and (*b*) when an animal that has been vaccinated against one strain of the virus is attacked by a variant. We were told in Denmark that masked infection of this last kind had occurred in that country. In Holland differing views were expressed: one veterinary official did not believe that the symptoms of the disease would be unidentifiable when infection occurred during waning immunity; another thought that the symptoms would be mild or that there would possibly be no clinical symptoms at all. The Swedish veterinarians told us that they had had no experience of masked infection in their country. In most of the other countries we visited, and in Great Britain, the veterinary experts thought that masked infection was possible with foot-and-mouth disease. The Royal College of Veterinary Surgeons went so far as to express the opinion that it was a strong possibility. In their evidence they said "There is always grave risk that if cattle which are only partially immune are exposed to natural infection they may contract the disease in a suppressed form which may pass unrecognised. Such animals are obviously a source of danger and may be responsible for the initiation of fresh outbreaks."

101. In countries where the disease is endemic, it is naturally difficult to obtain conclusive evidence about masked infection. We can say no more than that, in the absence of scientific proof, the possibility of masked infection in animals vaccinated against foot-and-mouth disease cannot safely be ignored. Masked infection is known to be a feature of other animal virus diseases against which vaccination is practised. We were glad to learn that the question is to be investigated experimentally at Pirbright.

102. It is in the light of the foregoing answers that we must examine the question whether limited vaccination could profitably be used in the country as an adjunct to stamping-out. We shall do this by trying to assess separately the usefulness, in the conditions of this country, of three possible courses, namely:

(i) to institute compulsory vaccination as an official policy in ordinary times,

(ii) to permit vaccination at any time by farmers wishing to undertake it,

(iii) to institute compulsory vaccination as an official policy in an emergency.

In order to examine these questions on their merits we shall leave out of account certain obstacles that now exist, but may prove transient, to the introduction of a vaccination policy in this country. We shall assume that adequate supplies could be provided of the most efficient vaccines now known to science (see paragraph 100 (a)) and we shall ignore the fact (except when we have occasion to mention it specifically) that the danger of masked infection is at present widely held to be a fundamental objection to any vaccination at all.

103. As will be seen from the description we gave in Chapter III of the methods adopted in foreign countries, compulsory vaccination as a routine precaution may take the form of (*a*) "Ring" vaccination or (*b*) "Frontier" vaccination or (*c*) the vaccination of special herds. We propose to examine separately the possible value of each of these methods in the conditions of Great Britain.

Ring vaccination

104. The object of Ring vaccination is to prevent an outbreak from spreading to neighbouring farms. The advantages claimed for it are that it is economical in money and effort, because it confines vaccination to a limited area known to be specially dangerous, and that it is specially likely to be effective because the type of virus will be known. Its weakness, as we have seen, is the probability that animals may become infected before the fourteen days have expired that vaccination takes to confer immunity, or the still longer period that must elapse if the virus has to be typed in order that the appropriate vaccine may be prepared. Even in those cases it is said to be of value in countries that do not practise stamping-out, for the disease will be milder in vaccinated animals. But that is immaterial in countries in which infected animals would be slaughtered, as they would in Great Britain ; and those are the countries—notably Sweden and Switzerland—to whose experience of Ring vaccination we must look for any lessons that might be useful for our own country.

105. In both these countries Ring vaccination is said to have given good results in reducing the number of subsequent outbreaks, and so the number of cattle that had to be slaughtered. But it is naturally impossible to say with certainty how far this reduction is attributable to vaccination, how far to variations in the nature of different outbreaks and how far to the improvements that have been effected in the speed and stringency of the other measures taken to confine the outbreak. A psychological value is also claimed for Ring vaccination. We are not sure that we know what that means, but if it is that a show of activity on the part of the authorities has a reassuring effect, we are not greatly impressed by the argument. If it is that Ring vaccination gives farmers confidence, we must put in the other scale the opinion we heard elsewhere that it is likely to generate an unwarranted complacency in them.

106. We do not think it possible to draw from the experience of these countries any definite conclusion, one way or the other, about the possible value of Ring vaccination in our own country, especially as in them the cattle population is less dense than here, and there are fewer sheep and pigs: Ring vaccination is therefore an operation of less magnitude and greater efficacy than it would be here. Its usefulness in this country must depend largely on the speed at which infection is likely to spread from the primary outbreak—the centre of the vaccinated zone—to other points in it. *Prima facie* there must be a strong probability that, if infection spreads to neighbouring farms, it will have done so before the infected premises have been put under the drastic restrictions that are always imposed as soon as the disease is confirmed. If the spread does take place at once, Ring vaccination is obviously useless as a precaution against infection from the primary outbreak, though it might have some effect in preventing further infection from secondaries. But we should be reluctant to base a conclusion on *prima facie* probabilities, and the Ministry have been good enough to supply us with the Table on page 47 showing over a period of twelve years at what distances secondary outbreaks commonly occur from the primary to which they are attributed, and how quickly they follow it. We must repeat the warning we gave on page 10 about the need to regard the classification into primaries and secondaries as containing an element of conjecture, but we think the general picture the figures give is probably accurate enough to justify us in drawing conclusions from them.

107. In considering these figures we shall assume that all outbreaks occurring more than fourteen days after the primary outbreak would have been prevented by vaccination in a zone of the size indicated, and that none of

those occurring within that period would have been, although, for the reasons given in paragraph 110, this will exaggerate the number that might have been prevented. We shall also assume that a zone fifteen miles in radius from the primary outbreak would ordinarily be regarded as the largest reasonably practicable for Ring vaccination. It would mean on average the vaccination of 275,000 animals; a ten-mile radius might mean 120,000 and a five-mile 30,000.

108. Since it is at once apparent, on looking at the figures, that the years in which the disease was sporadic (1943-1950) show a rather different picture from that of the three when it was epidemic (1942 and 1951-52), we shall separate the two periods so as to consider separately the value of Ring vaccination as a routine measure and its usefulness in an emergency.

109. On these assumptions, it appears that the percentages of secondaries that might have been prevented by Ring vaccination are:

In normal years

17 per cent. of those within a vaccinated zone of five-mile radius.
23 per cent. of those within a vaccinated zone of ten-mile radius.
*23 per cent. of those within a vaccinated zone of fifteen-mile radius.

In epidemic years (1942 and 1951-52)

60 per cent. of those within a vaccinated zone of five-mile radius.
64 per cent. of those within a vaccinated zone of ten-mile radius.
†66 per cent. of those within a vaccinated zone of fifteen-mile radius.

110. Sir Thomas Dalling, in his evidence to us, said that he found it difficult to see the advantages of Ring vaccination when combined with stamping-out. "The results are no better", he said, "nor is the infection eradicated more quickly than in Great Britain, where only a slaughter policy is practised". We think that the first set of percentages given above, bears out this opinion when applied to routine Ring vaccination in normal times. If it had been carried out in 1953, for example, much money would have been wasted. Twenty out of the twenty-five primaries in that year were stamped out by slaughter without any spread taking place, and vaccination would therefore have been done unnecessarily around these. The five primaries from which spread did occur resulted in fifteen outbreaks, but only two of those were so long afterwards that they might have been prevented by vaccination. To have vaccinated in rings of fifteen miles radius around all the primary outbreaks in 1953 would have cost in vaccine alone something between £550,000 and £1,200,000. (See paragraph 107 and Appendix XV.) The corresponding figures for a five-mile zone are £60,000 and £130,000. The compensation paid for the animals slaughtered in the two outbreaks that might have been prevented by vaccination was roughly £8,000, and the amount in those two cases was considerably above the average for the year. Our conclusion is that the adoption of Ring vaccination, in the circumstances of this country, would not in normal times make any contribution to checking the disease that would justify the expense and diversion of effort it would entail. This conclusion is strengthened by the fact that the calculations on which it is based inevitably exaggerate the number of outbreaks that vaccination would have prevented. Some of these secondaries will have been among sheep and pigs, for which existing vaccines are of very doubtful value (see paragraph 100 (*e*)), and even among cattle the figure is inflated for the reason given in Note (*a*) to the Table. We return in paragraph 127 to the question of Ring vaccination in an emergency.

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* or 21 per cent. of all the secondaries that occurred.
† or 57 per cent. of all the secondaries that occurred.

Year	Number of primaries	Number of primaries from which infection spread	Total number of secondaries	Numbers of secondary outbreaks							
				Within 5 miles of the primary		5–10 miles		10–15 miles		Over 15 miles	
				within 14 days	over 14 days	within 14 days	over 14 days	within 14 days	over 14 days	within 14 days	over 14 days
1942 ...	40	30	630	143	307	21	109	5	39	2	4
1943 ...	6	3	20*	11	5	2	1	1	—	—	—
1944 ...	93	25	88	56	9	13	5	3	—	2	—
1945 ...	66	22	63	48	5	8	—	1	—	1	—
1946 ...	34	8	20	12	3	5	—	—	—	—	—
1947 ...	22	14	82	24	12	10	19	4	1	6	6
1948 ...	6	6	9	5	1	1	1	—	—	1	—
1949 ...	7	3	8	7	1	—	—	—	—	—	—
1950 ...	14	3	6	5	1	—	—	—	—	—	—
1951 ...	57	22	59	33	14	8	2	—	—	2	—
1952 ...	83	45	412	85	65	20	58	4	30	3	147
1953 ...	25	5	15	8	2	—	—	4	—	1	—
TOTALS ...	453	186	1,412	437	425	88	195	22	70	18	157

* Includes 7 spreads from 1942 primaries.

Summary

Total number of secondaries 1,412

Total number of secondaries that might have been prevented if vaccination had been carried out in a ring of 5 mile radius around the primary outbreak—

allowing 14 days for production of immunity ... ... 425†

Total for a ring of 10 mile radius ... ... 620†

Total for a ring of 15 mile radius ... ... 690†

NOTES

(*a*) †These figures show the highest possible number of secondary outbreaks that vaccination might have prevented. No allowance has been made for the incubation period of the disease which varies on the average from three to ten days. Thus in an unknown number of the cases shown in the table as likely to have been prevented by vaccination, the animals might in fact have been incubating the disease before immunity could have been produced.

(*b*) The total number of secondaries includes those outbreaks that spread from secondaries.

Frontier vaccination

111. The circumstances in which Frontier vaccination is employed in countries with a land frontier are of course quite different from those in this country. In ordinary times we have no frontier that could serve as a barrier by the immunisation of the animals to a certain depth within it. In normal years a primary outbreak of foot-and-mouth disease is as likely to occur in Cheshire or Worcestershire as in Kent. But there are occasions—the epidemic of 1951-52 was one—when an invasion of virus from Europe, borne by birds or in the air, falls with initial force on our eastern or south-eastern seaboard. Reference to the maps in Appendices VI and VII will show that a protective belt in Norfolk and Suffolk in 1951 and in Kent and Sussex in 1952 might have been of no little value. But to try to make a permanently immunised belt between us and the Continent would be out of the question. The potential frontier stretches from Yorkshire to Dorset, and regular vaccination on this scale would mean a vast expenditude utterly disproportionate to any possible gain. Nevertheless, in weighing the possible advantages of vaccination against its disadvantages we do not think (subject to what we shall say later in this Chapter) that it would be right to regard as negligible the possible value of defence in a coastal belt against an invasion similar to that of 1951-52, if it became clear that a limited area was the main point of attack. It is true that this could not be done until the point was known, and might therefore be belated: on the other hand the type of virus would probably be known and a monovalent vaccine could be effectively used. This is done in the south of Sweden when the disease is rife in Denmark. But there the point of attack predetermined by geography is much smaller, and action can be taken in good time. Whether it would be worth while on any part of our coast—assuming that there were no fundamental objections to employing any vaccination—is a question that could only be decided in the light of the circumstances when they arose. What is quite clear is that in ordinary times a policy of Frontier vaccination would not be suitable for Great Britain. Even in Continental countries it is only a second-best: the proper way of tackling the problem is by international action.

Compulsory vaccination of particular herds

112. Among the countries whose methods we have examined, Sweden is the only one to adopt this policy. As we have said, stamping-out is the normal way of combating the disease in that country, and we were told there that it has been found to be generally cheaper, as well as more effective, than isolation. But an exception is made of certain "listed" herds which are of special value and for which compensation would be specially high if they were slaughtered. If foot-and-mouth disease breaks out in any of these, the cattle are normally not slaughtered, but the herd is isolated and the disease allowed to run its course. When foot-and-mouth disease is present in the country, or threatens it (but not at other times), the law requires these herds to be vaccinated against the specific type of virus concerned. The reason for insisting on the vaccination of herds exempt from slaughter is that if they got the disease they would be a source of exceptional danger; they would become potential foci of infection for perhaps many weeks. With us no exception is made to the slaughter of infected herds, and we do not think that any ought to be made, so long as stamping-out remains practicable. In Sweden, where the cattle population is sparser than here, a policy of isolation can be followed with less risk. In Great Britain therefore no one herd is more likely than any other to become a specially dangerous focus of infection if it contracts the disease, and to demand in consequence the special precaution of vaccination.

113. There are other differences too. In Sweden the disease almost always enters the country by way of an invasion from Denmark ; the type of virus is known in advance and there is time to get supplies of the right monovalent vaccine. Great Britain is at all times exposed to sporadic infection, by virus of types that cannot be anticipated with any certainty, from both European and South American sources. There could be no possible justification for compelling the owner of any particular herd in this country to vaccinate in normal times. His risk is extremely small—on average only 0·06 per cent. of our cattle population is slaughtered annually owing to infection or contact with it—and his protection would be problematical owing to the impossibility of predicting the type of virus. Whether he should be permitted to vaccinate if nevertheless he wants to do so is a question we shall discuss later (paragraph 115).

114. It is true that there are occasionally invasions here of the same sort as Sweden has. But if a system of compulsory vaccination were introduced at such a time to assist in combating the invasion, the plan of campaign would obviously have to be determined solely by what was best calculated to check the spread of the disease (see paragraphs 126-128) not by what herds were best worth protecting against the risk, possibly remote, of their getting it.

Voluntary vaccination

115. Voluntary vaccination is common in countries where foot-and-mouth disease is endemic and stamping-out is impracticable : France, Belgium and Argentina are examples. In the countries that combine the two methods (notably Sweden, Switzerland and Holland) Holland alone permits it, and indeed encourages it. But here again inferences about the suitability of the methods of other countries to the conditions of our own must be drawn with caution. Holland is trying to establish a system of universal vaccination, a policy which, as we have seen, is not feasible in Great Britain, and would be a waste of money if it were. Switzerland does not allow sporadic vaccination, on the ground that it might interfere with the efficiency of stamping-out. The Swedish practice has already been described, and its unsuitability to our conditions explained. We do not think that on this point there are any useful lessons to be learned from foreign experience.

116. The case for voluntary vaccination can be stated in its most cogent form by putting an imaginary plea into the mouth of an imaginary stock-breeder. "I lost", he might say, "a herd twenty years ago through foot-and-mouth disease, and I have now built up another. I am willing to go to any trouble and incur any reasonable expense that may lessen the risk of my losing my new one. I know the odds against its happening again are long. I know that my young calves may never be immune and that my adult cattle may be attacked by some different strain. I know that vaccination does not give complete protection even against its own strain. I will use no vaccine that is not passed by Pirbright. I will vaccinate as often as I am required to. I will bear the whole cost myself. I will accept any restrictions that may be imposed on the movements of my herd. I recognise that if any of my animals should get the disease the herd will have to be slaughtered. Why should I not do it? I shall be better off, if only by my increased peace of mind, and the community will be no worse off."

117. We have no reason to suppose that there is any general desire among the farming community to be allowed to vaccinate, but a plea of this sort was put forward in the course of our evidence. Numerous objections can of course be raised. It may be said that the risk to be insured against is

too slight, and the protection too uncertain, to justify the premiums ; and that it would be wrong for the Government, by providing the vaccine, to give the appearance of associating themselves with an exaggerated idea of the value of what they were selling, and of encouraging what many would think a waste of money. It may be said (as the Swiss authorities say) that the presence here and there of vaccinated herds in varying stages of immunity would increase the difficulty of tracing and checking the spread of the disease in the event of an epidemic. It may be said that the periodical inspection of vaccinated herds and keeping records of them would impose an undue burden on the veterinary staff of the Ministry. It may be said that if vaccination were once permitted for any owner of livestock an embarrassing number of others would demand it, and discrimination would be impossible. The force of these objections depends largely on the number of people who would wish to take advantage of an opportunity to vaccinate. As we have said, we have no evidence of any widespread desire to do so—rather the contrary—and we think it unlikely that many would consider that the dubious protection such vaccination would give was worth the trouble and expense. If the objections we have recited are considered as arguments against allowing some few farmers to practise vaccination in normal times (and to continue it during epidemics) we do not think they are conclusive, though we do not suggest that they are negligible.

Masked infection

118. But these objections did not provide the arguments on which the greatest emphasis was laid by those of our witnesses who opposed permissive vaccination. What was put to us by witness after witness as the reason why it ought not to be done was the danger of masked infection (see paragraph 100 (*g*)). The argument is this: that since there is a possibility that vaccinated animals may contract the disease and become infective without showing any symptom easily recognisable, they might spread the disease without the source of infection being discovered, and the additional risk that vaccination might thus bring with it would more than counterbalance its very speculative value.

119. As will be clear from the evidence we have summarised, it is impossible to quantify this additional risk. If vaccinated herds were no large proportion of the cattle in the country, the additional risk could hardly be other than slight. Few, if any, vaccinated animals would be likely to be among the 0·06 per cent. of our cattle population which on average are exposed to infection annually, and even fewer could become a source of danger as masked carriers. Whatever additional risk there might be, it can hardly justify the fears expressed by some of our witnesses about the dire results that must almost inevitably follow the introduction of any vaccination. We think there is a tendency—natural enough in the circumstances—to magnify the unknown. But as long as we know so little about masked infection, the possibility of some additional risk cannot be dismissed, and we are bound to give due weight to the fact that, with rare exceptions, our witnesses—official, veterinary and farming alike—were emphatic in their conviction that the risks to the farming community in general that would come from permitting vaccination far outweighed any possible benefit to any individual members of it. The same opinion is held no less strongly in the United States, Canada and Norway. Moreover it would obviously be inopportune to permit what is widely held to be a dangerous practice, in a country where the disease is not endemic, at a time when the reality of its danger is about to be scientifically investigated. We cannot recommend that voluntary vaccination should be allowed pending the result of those experiments. We think that the question should then be considered afresh ; by that time, moreover, further progress may have been made in improving the efficacy of vaccines.

120. Countries that are free from the disease are exceedingly sensitive about masked infection. In the United States the law prohibits the importation of any susceptible animal from any country in which any vaccination is practised. We think it almost certain that, if any vaccination were introduced here, Canada, Australia and New Zealand would also refuse to import from us. The value of our exports of cattle and sheep to these countries was £390,000 in 1953. This may be no great matter viewed as a contribution to the country's balance of payments, but the continuance and development of the trade is most important to our livestock industry, both in prestige and, to individuals, materially. This provides an argument against vaccination that will have to be taken seriously if ever its introduction is thought to be desirable on other grounds.

Vaccination in an emergency: the work of the Pirbright Institute

121. In 1923 Britain was forced into a partial abandonment of stamping-out, and in some later epidemics there were some anxious moments. It is common prudence to consider what ought to be done if another great epidemic were to result in the disease becoming so widespread that stamping-out was no longer practicable or economic. In 1923 the alternative was isolation. The Committee of that time condemned isolation, but pointed out that the position would be materially altered by the discovery of some vaccine that would confer temporary immunity from attack. Great strides have since been made in that direction, and the general opinion of our expert witnesses—even of those most strongly opposed to vaccination in present conditions—was that preparations ought to be made for the use of vaccination in such an eventuality. To undertake vaccination at such a time would be very different from allowing it while the disease was sporadic, for it may be assumed that during an epidemic the types of virus against which protection was needed would be known, that specific vaccines would be available and that the areas in which vaccination might be an effective barrier could be predicted with some confidence. We agree that such preparations ought to be made. Indeed, the plans now in hand for the expansion of the Pirbright Institute (see paragraph 123) seem to indicate that the need for them is already officially recognised.

122. Similar action is being taken even in the United States, which has been free from the disease for 25 years. In July, 1952, Congress appropriated ten million dollars for the construction of a foot-and-mouth disease research laboratory. In this it is proposed to carry out research into the artificial cultivation of the virus to facilitate vaccine production and the development of more effective and less expensive vaccines. The following are extracts from a statement issued at that time by the United States Department of Agriculture:

> "Full-scale research on the disease is of utmost importance since much more information is needed than is now available to develop better methods of control and eradication. Foot-and-mouth disease is one of the world's most costly and far-flung livestock infections. The United States is now one of a very few countries still free from foot-and-mouth and the country's multi-billion dollar livestock industry would suffer a telling blow if it became established here . . . . Obviously this country can't afford to wait until an emergency exists before beginning research on foot-and-mouth disease, nor depend upon present contacts with foreign laboratories that could be terminated abruptly by international complications. Therefore, every effort will be made to begin construction of the laboratory as soon as possible and to facilitate its erection and operation.

Its objective will be to 'know thy enemy' so as to battle successfully against the disease should it invade the barriers of inspection and quarantine at our borders and form a threat that could cost the country fully $200,000,000 a year in losses of milk, meat and meat production."

123. In England the Research Institute at Pirbright is being extended: new buildings are being erected and additional plant installed. It is expected that the work will be completed by March, 1955. Its purpose is to enable the research activities of the Institute to be extended in all directions, including research on new and improved methods of immunisation and in vaccine production. Vaccines are already being made at Pirbright; the Institute could produce up to 40,000 doses a week. We were told that, when the expansion programme is completed, it will be possible to produce 100,000 doses a week. It is not proposed always to produce vaccine at full capacity. The period for which vaccine can be stored and remain fully effective is not yet known; the method of storage requires further investigation; variants of the virus might appear against which the stored vaccine would not be effective, and the research now being carried out may result in advances in the effectiveness of vaccines and the techniques of their manufacture. The Institute regard their programme for vaccine production as one that would serve as a foundation for large scale production if stamping-out had to be abandoned.

124. We think it our duty to point out that, as a precaution against an epidemic so severe that stamping-out had broken down, a productive capacity that provides for the vaccination of not more than 100,000 cattle a week hardly seems adequate. We do not suppose that there would be any technical difficulties in supplementing this by arranging for vaccine to be made also by commercial firms. But we should feel the gravest misgivings about such a policy. If Pirbright's production had to be reinforced in this way, it would be no use waiting until the need arose; plants would have had to be erected and tested experimentally beforehand. The objections that we see to doing this cannot be removed by pointing to the fact that in other countries, notably Argentina, private firms manufacture vaccine. It is a much less risky business in countries where the disease is endemic than it is in countries where all animals are susceptible. In these the extreme infectivity of the virus calls for extraordinary precautions, most burdensome to those who are engaged on the work, against infection being accidentally conveyed outside the premises.* It would not be easy for business firms to undertake the responsibility of making sure that these safeguards were rigorously observed. Moreover the manufacture of vaccine, and the testing of it for innocuity and effectiveness, demand a high degree of technical skill, and of knowledge of the dangers involved, which is not easily learned by those new to the task but is possessed at Pirbright as fully as anywhere in the world. If the contemplated capacity of Pirbright is inadequate, as we think it must be for the purpose for which we understand it to be intended, the expansion of it would certainly be safer and more effective, and would probably not be more expensive, than its supplementation by manufacture by private firms.

125. Some of our witnesses—though not many—showed a disposition to criticise the Pirbright Institute on the ground that they occupied themselves too much with pure research and ignored the possibilities of vaccination.

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* For this reason Congress stipulated that the American Institute must be on an island, as it is in Denmark. But this has disadvantages as well as advantages. The isolated position of the Danish Institute has proved a fruitful source of troublesome staffing difficulties.

We are quite satisfied that this is not so. The Institute have long been alive both to the important part that vaccination is playing in reducing the incidence of the disease in Europe, and so lessening the danger to this country, and also to the chance that vaccination might be needed here in an emergency. Within the limited resources that have hitherto been available to them they have devoted much time and labour to the production and testing of vaccines. Indeed, the ready availability of susceptible animals here has enabled them to carry out investigations into vaccination that are not possible in countries where the disease is endemic. The Institute hold the largest collection of strains of foot-and-mouth virus in the world. Over 5,000 cattle have been used there for testing vaccines. Eight different methods of vaccine manufacture have been investigated. Our visits abroad left us with the impression that the Institute is held in unique esteem by veterinary experts in all countries; Pirbright seems to be generally regarded as the most important centre in the world for foot-and-mouth disease research. Evidence of this is furnished by the facts that samples of suspect foot-and-mouth virus are constantly sent to Pirbright for examination and typing from all over the world and that many countries have sought advice about such topics as disinfection and other ways of dealing with outbreaks, or have sent representatives to study the work being done at the Institute. The Institute have never advertised themselves, and we are glad to have the opportunity of paying tribute to the exceptional quality of the staff and the great value of the work being done there. We feel some concern however about the present arrangements for the administration of the Institute. We do not think that they can be entirely satisfactory until the responsibilities of the Governing Body of the Institute and their relationship with the Minister of Agriculture on the one hand and the Agricultural Research Council on the other have been more clearly defined than they seem to be at present. It was also represented to us that the time was ripe for the creation of a separate Veterinary Research Council, analogous to the Medical Research Council, which should be responsible for the initiation and co-ordination of research into all animal diseases. To discuss these questions would take us outside our Terms of Reference and we must content ourselves by saying that it seems to us essential to clear up the first point and that the second deserves careful consideration.

126. It is obviously impossible to define beforehand the state of affairs which would justify recourse to organised vaccination. In calling attention to the wisdom of being ready for such a measure in case an epidemic should become so serious that stamping-out had to be abandoned, we did not mean to suggest that that point should be awaited before vaccination was begun. On the contrary it would clearly be prudent to act earlier, and use the two methods in combination in order to reduce the number of animals that had to be slaughtered. But at just what stage of an epidemic this should be started can only be decided at the time, in the light of all the circumstances then existing, including the supplies of vaccine available and the advances that by then may have been made in scientific knowledge. It would be idle for us to try to give any guidance on the point. Nor is it easy to say in advance what would be the proper tactics for such a campaign: these also must depend on the circumstances at the time. But as we have closely studied the methods followed in many countries, it may be worth while for us to record briefly certain general conclusions.

127. We have already said in discussing Frontier vaccination that conditions might occur in which it was worth while to vaccinate in any coastal belts that might seem to be points of concentrated attack by virus conveyed direct from an epidemic on the Continent, though experience suggests that

such occasions are likely to be rare, and it might be difficult for action to be taken promptly enough to be effective. Ring vaccination also might sometimes be useful, less perhaps for preventing infection from the original primary than for confining spread from its secondaries. At the beginning of June, 1952, for instance, an outbreak near Dumfries was followed during the ensuing three months by 82 secondary outbreaks in the counties of Dumfries, Kirkcudbright and Cumberland and the slaughter of 18,000 animals. If it had been practicable at the beginning of June promptly to carry out Ring vaccination with monovalent vaccine of the right type, it seems probable that many of these might have been saved. As the Ministry emphasised in their evidence, however, it is easy to be wise after the event, and it is exceedingly difficult, if not impossible, to distinguish beforehand between the cases where Ring vaccination would be a waste of money and those in which it would pay handsome dividends.

128. It seems to us probable that in the circumstances we are contemplating, the more promising tactics would be neither Ring nor Frontier vaccination, but might be those adopted in Mexico in November, 1947 by the joint United States—Mexico Commission (see paragraph 87). There, when vaccination was introduced to supplement slaughter, the campaign began with the vaccination of animals in zones round the periphery of the infected areas, so as to create sanitary cordons as barriers to the spread of the disease. This was thought to be a better method of confining the disease than vaccination within the infected areas, where it was likely that some of the animals vaccinated might be already incubating the disease, or be attacked by it before immunity was established. When the sanitary cordons had been made, vaccination was extended by working from the periphery towards the centre of the infected area. In spite of the very different conditions in Mexico from those here, we think that the tactics of that highly successful campaign for eradicating the disease by vaccination and slaughter combined might well serve as a model, especially the principle of first concentrating on producing immunity in cattle unlikely to have been infected, and working inwards towards the focus of infection, rather than working outwards away from it.

The use of serum

129. In some of the countries we visited, serum is occasionally used instead of vaccine for protecting susceptible animals from foot-and-mouth disease. Serum is produced from the blood of infected cattle after they have recovered from the disease, and it contains antibodies against the virus that caused the attack. Although it has the advantage of producing immunity almost immediately, the duration of that immunity is very short; it is generally estimated to be between ten and twenty days. In Denmark, calves and pigs in contact with infection are sometimes injected with serum, and when that is done the immunity thus acquired may last for some months. Serum is used also to reduce the severity of the attack in animals that are already infected, although it will not modify the course of the disease once lesions have appeared. The Ministry used serum experimentally in field outbreaks between 1930 and 1935. The treatment did not always prevent the injected animals from getting the disease; some were in the incubative stage when treated and others picked up infection after the effect of the serum had passed. As the result of this experience the Ministry reached the conclusion that serum had no useful application in this country.

130. The study of serum has been continued since that time and many advances have been made in the knowledge of it. But they have not

increased its value as a prophylactic. The general opinion among the experts in this country seems to be that, except for the rapidity of its action, serum has all the drawbacks of vaccination and none of its advantages; it is moreover very expensive. We see no reason to question this conclusion.

Alleged cures and preventives

131. Among our witnesses were a few who contended that the stamping-out policy could be avoided by using methods already available for curing or preventing the disease. To suppose that this could be achieved by a "cure" is to misconceive the nature of the problem. As we have said, the main mischief of the disease lies in its extraordinary infectivity and the persistence of its after-effects. There is no difficulty in curing the disease even without professional assistance. It usually runs its course in two or three weeks, after which the great majority of the animals recover naturally. The justification of the stamping-out policy is not that the disease is incurable but that infected animals continue to propagate and disseminate the virus if it is allowed to run its course. No "cure" could affect the case for the continuance of the stamping-out policy unless it were one that eliminated the principal menaces of the disease by immediately stopping the excretion of virus and by ensuring complete recovery without any after-effects. We have no reason to suppose that such a cure exists. The only witness who claimed to have one was unwilling to disclose its nature and produced no evidence in support of the claim.

132. Two witnesses described methods that they maintained would prevent the disease. One was based on the proposition that natural feeding and natural rearing confer immunity against disease generally. The witness in question had no evidence that this was so in the case of foot-and-mouth disease, but believed it to be probable. But there does not seem to be any correlation throughout the world between the incidence of foot-and-mouth disease and the use of artificial fertilisers and manufactured feedingstuffs. Even if it were true that the disease could be got rid of by using no artificial feedingstuffs or fertilisers, its extirpation by these means in this country would be clearly impossible.

133. The other preventive method was based on a theory that in all virus diseases it is possible to make a bacillary culture from the virus and to prepare an antigen from the dead bacilli, and that a vaccine manufactured in this way is better than one prepared from the virus itself, as is now customary. As regards foot-and-mouth disease in particular, the witness who propounded this theory claimed the following advantages for it: that the vaccine was much cheaper to make, that it could not possibly infect an animal with the disease or produce carriers, that it conferred immunity for thirteen months at least, that this immunity was probably transmissible from parent to offspring, and that a stock antigen prepared from any strain would be effective against all strains. In support of this claim the witness who put it forward told us of experiments between 1940 and 1943 on eighteen establishments in Argentina and Uruguay, and gave us a summary of results as follows:

> "Observation was left to the farmer, with the request that a report be made a year after vaccination. Summarised, they show that of 1,409 animals treated, only 132 were affected though infection ran to 100 per cent. among untreated cattle: of those which sickened, most contracted only mild attacks, and of the total only 10 died, those having had the disease before injection on a ranch where mortality was reported as 50 per cent., with 10 deaths in 145 cattle representing 6·9 per cent."

Laboratory experiments were also made at Pirbright in 1939. The result was negative, but the claimant asserts that the tests were not thorough enough to disprove his theory, and urges that further experiments should be made.

134. The theory that bacilli can be grown from a virus runs counter to generally accepted scientific belief ; the propounder of it said in his evidence before us that its acceptance would mean " rewriting all the bacteriological text-books in all the civilised languages of the world ". We are not of course suggesting that this necessarily means that the theory is false ; the history of scientific discovery contains plenty of examples of theories at first rejected by orthodox opinion which eventually established themselves. But it does mean that the issue thus raised is concerned with fundamental scientific beliefs in the field of bacteriology which range far outside our Terms of Reference and on which we are not competent to express an opinion. All that we are called on to consider is the request made by this witness that we should support his plea for more exhaustive experiments at Pirbright. In deciding this question we must be guided by the evidence he submitted to us about the results of the experiment made in South America twelve years ago. That experiment was on a small scale ; it was not under scientific observation, and it took place in a country where the disease is endemic, and the probability of residual immunity after natural attacks of the disease makes it necessary to discount inferences that might be drawn from similar experiments made on fully susceptible animals. If we put the case at its highest by ignoring these possible sources of error, and if we assume that the results of the experiment were correctly observed and reported, and that all cases of immunity in vaccinated animals were rightly attributed to vaccination, the conclusion—that this form of vaccination can give nearly 92 per cent. immunity—is that its efficacy is much the same as what we know orthodox vaccination to be capable of.

135. The present attitude of the Governing Body of Pirbright is that there is no such *prima facie* scientific evidence in favour of this theory as would justify them in diverting any further effort from the promising research on other lines now being carried on there. We must not be taken as expressing any opinion on the scientific validity of the theory when we say that, although it may be that the test made at Pirbright in 1939 was not thorough enough to provide in itself conclusive evidence against it, we cannot regard the evidence submitted to us in its favour as justifying us in pressing the Governors to reconsider their attitude. No evidence was produced in support of the claims that the immunity it gave lasted longer, that it was transmissible from parent to offspring, that it could not produce carriers and that an antigen prepared from any strain would be effective against all strains.

Conclusions

136. Our conclusions on the policy for dealing with the disease in this country may be summed up as follows. The choice lies between (i) stamping-out, (ii) vaccination and (iii) a combination of the two. There is no other method of proved efficacy. In the present state of scientific knowledge the right policy for a country where the incidence of the disease is as low as it is in Great Britain is stamping-out. Great progress has been made of late in the preparation of vaccines against foot-and-mouth disease ; research is still being vigorously pursued all over the world, and further progress can confidently be expected in overcoming the difficulties and remedying the imperfections that still remain, though the shortness of the immunity and the multiplicity of strains present many intractable problems. But we find it significant that countries whose official policy is vaccination alone do not

follow it because they think vaccination better than stamping-out, but in the hope of reducing the incidence of the disease to a point where stamping-out could be adopted. For the reasons we have given fully in earlier paragraphs, we do not recommend that the Ministry should undertake any vaccination as a means of combating the disease in ordinary times, when it is sporadic. Apart from other considerations, we are satisfied that the results would not justify the cost. With the suggestion that farmers who wish to arrange for vaccination at their own expense should be permitted to do so we have much sympathy. But it would clearly be wrong to allow this just at the time when the validity of the main objection urged against it—the danger of masked infection—is about to be scientifically investigated. If the result of this investigation is to show that the danger is negligible, and if the disease-free cattle-importing countries can be persuaded to the same opinion, we think that the question of permitting this, subject to whatever conditions it may be considered necessary to impose, might be considered afresh. In combating what we have called a severe epidemic, on the other hand, we are convinced that vaccination might be a most valuable weapon—indispensable even, in certain circumstances—and we welcome the decision of the Government to prepare for such a contingency. But we cannot regard as adequate the productive capacity contemplated for Pirbright under the present reorganisation plan. If arrangements are to be made for the large-scale manufacture of vaccine at Pirbright, as we agree they ought to be, the scale should be large enough to be of real use in a crisis.

CHAPTER V

ARRANGEMENTS FOR DEALING WITH THE DISEASE IN GREAT BRITAIN

137. In considering whether the present methods adopted in Great Britain for checking the spread of foot-and-mouth disease are capable of improvement in detail, it will be useful to see whether any lessons can be learned from the course of events in the 1951-52 epidemic. A full account of this epidemic is given in Appendix V. As is there explained, it falls naturally into three groups in both place and time—(i) Eastern England, (ii) Southern England and (iii) Cheshire, the Midlands, Wales and Scotland. The most striking fact that emerges from a study of what took place in these groups is that the system of control was far less effective in the third than in the other two. In the first, 87 primaries caused 65 secondaries, or rather fewer than one apiece. In the second, 40 primaries caused 95 secondaries, or rather more than two apiece. In these two therefore a heavy invasion from abroad was resisted with no small success. The story of the third is very different. In this there were only six primaries, but the spread from them was catastrophic: they led directly or indirectly to no fewer than 290 secondaries. Indeed the true picture is probably even worse, for it now seems likely (see footnote to page 98 of Appendix V) that five of the outbreaks classed as primaries were probably secondaries, and that in fact a single primary of unknown origin—that at Checkley, near Crewe—was the cause of 295 secondaries. This means that, if the outbreak at Checkley had been effectively confined, half of the 583 outbreaks that took place during the 1951-52 epidemic might have been prevented.

138. The primary reason for this misfortune is not in doubt. It was that the outbreak at Checkley was not reported early enough to enable that focus of infection to be promptly stamped out. The disease was four days old before the true diagnosis was made, and then the harm had been done. Within eight days of the disease being confirmed at Checkley, outbreaks had occurred on 22 other farms within a radius of five miles.

139. That was the primary reason. But two subsidiary causes of spread in this group are also of special interest. The first was that calves en route from the south of England to Scotland were fed at Crewe station with milk from herds in the locality that were found a day or two later to be infected. This was the way the disease was introduced into Scotland and thence into Cumberland: to the feeding of these calves at Crewe nearly a hundred subsequent outbreaks must be attributed. It is worth recording, as illustrating the difficulty of diagnosing the disease in young stock, that, when some of these calves died unaccountably after reaching their destination, a post-mortem examination revealed nothing that led to a suspicion of foot-and-mouth disease. It was only when adult stock that had been in contact with them developed typical symptoms that enquiries were made and the source of the infection traced.

140. The second subsidiary cause that deserves special mention was infection by meat from animals slaughtered as contacts. Among the outbreaks caused directly by the calves from England was one in Wigtownshire. Some of the contact animals slaughtered in consequence of this outbreak were apparently healthy and their meat was salvaged. Scraps of it eventually found their way to a piggery near Dumfries and were used as ingredients in swill that was stored unboiled in bins in the open close to the animals that were the first in this district to take the disease. This is regarded as having been the origin of what was by far the worst part of this series of outbreaks—the 83 that followed rapidly in Dumfries, Kirkcudbright and Cumberland.

141. The spread of the disease during this epidemic was doubtless promoted in many other ways, such as human contacts, milk, milk churns, churn washings, milk lorries and cattle lorries not properly disinfected. We shall consider all these, as well as the three we have singled out for special mention, in the following review of the manner in which stamping-out is at present operated in this country. This rests basically on the designation of affected farms, and areas specially liable to infection from them, as "Infected Places", "Infected Areas" and "Controlled Areas".

The Infected Place

142. What is technically known as the "Infected Place" is the farm on which a suspected outbreak has been reported and the appropriate notice served. The most important result of declaring a farm an Infected Place is that no persons may enter or leave it, nor may anything be moved onto or off it, without permission of the veterinary officer until the susceptible animals on it have been slaughtered and their carcases disposed of, and the premises have been disinfected. We have no comment except to emphasise the vital importance of not permitting any movement from the farm that is not absolutely necessary.

The Infected Area

143. This is an area round the Infected Place within which restrictions are placed on the movement of susceptible animals and out of which no susceptible animal may be moved. Its standard size is an area with a radius of fifteen miles around the Infected Place. The standard is not applied rigidly;

sometimes the area is a little larger, sometimes a little smaller, in order to provide well-defined boundaries. Or it may be given a bulge so as to take in something that it is convenient to include, such as a slaughterhouse.

The size of the Infected Area

144. Several witnesses thought that this area was unnecessarily large ; they represented that the restrictions imposed in an Infected Area inflict much inconvenience and sometimes heavy losses on farmers, and urged that it ought not to be larger than what could be shown to be necessary as a reasonable precaution. Evidence bearing on this can be found in the Table on page 47 of Chapter IV, which shows the distances from primary outbreaks at which secondaries commonly occur. It appears from this Table that, of the secondaries occurring within 15 miles, 92 per cent. have been within 10 miles of the primaries to which they were attributed. An area with a radius of fifteen miles covers 700 square miles ; to substitute a radius of 10 miles would reduce the area to less than half that size. There would no doubt be some element of risk, but we do not think it is serious enough to justify the imposition of these burdensome restrictions beyond what experience shows to be the main danger area. Moreover, although it is clear from the evidence given to us that the farming community generally co-operate conscientiously in observing the restrictions, a smaller area would be easier to control effectively and might make for even readier co-operation, because the reasonableness of the restrictions would be less likely to be questioned. We accordingly recommend that the standard size of the Infected Area should have a radius of ten miles, instead of fifteen miles, from the Infected Place. We recognise that in some cases this reduction might result in an Infected Area being without the slaughtering facilities that would have been comprised in one of a larger size. But we do not think this outweighs the advantages of the smaller size, and the Ministry should continue to have discretion to increase the size in any outbreak where they thought it necessary in the light of all the circumstances obtaining at the time or of subsequent developments.

The description of Infected Areas in the Ministry's Orders

145. Some of our witnesses criticised the present method of defining Infected Areas by reference to the boundaries of parishes, or the group of parishes composing a Petty-sessional Division ; this was said to be inconvenient because few people know just where parish boundaries run. That is no doubt true. But the area must have a definitely ascertainable boundary, and the only reasonable alternative to the present practice is to make one by specifying topographical features such as roads, railways and rivers. This is not always practicable. When it is, we understand that the Ministry sometimes do it already, especially when to follow the boundary of a parish would make an Infected Area unnecessarily large. We do not recommend any change.

Signposting of Infected Areas

146. During the 1951-52 epidemic the Berkshire County Council erected signposts on roads leading into an Infected Area to warn the public that they were entering a district which was infected with foot-and-mouth disease. Several of our witnesses commended this practice. They thought for instance that it would be of value in preventing livestock hauliers, who were sometimes ignorant of the boundaries of an Infected Area, from driving into one. They also thought that it would be useful in making other people entering the Infected Area careful where they went. We agree that this is a practical and useful method of publicity, and we recommend that at least the main roads leading into Infected Areas should be signposted in this way.

The closing of footpaths and roads in Infected Areas

147. The Ministry's veterinary officers, and the officials appointed by local authorities as Inspectors under the Diseases of Animals Act, have power to close footpaths in Infected Areas. But not all the local authorities have appointed police as Inspectors under the Act, and, even where they have, only some of the police are so appointed. In view of the danger of the disease being spread by people who use footpaths in Infected Areas, particularly where cattle may wander over them, our witnesses thought that the police should be empowered to close footpaths in Infected Areas. We agree and recommend accordingly.

148. As it is sometimes necessary to disinfect roads over which diseased animals have passed, we recommend that both the Ministry's veterinary officers and the police should have power to close roads while this is being done.

Artificial insemination in Infected Areas

149. There has been a remarkable expansion recently in the practice of artificial insemination. In 1945-46 about 25,000 cows were artificially inseminated in England and Wales. In 1952-53, according to the Report of the Production Division of the Milk Marketing Board (of England and Wales), the figure was well over a million, or 39 per cent. of all cows impregnated. We have therefore thought it right to go closely into the restrictions that are placed on this service when foot-and-mouth disease breaks out. It has become such an important feature of the cattle-breeding arrangements in this country that risks may have to be accepted now which would have been unjustified some years ago. What restrictions are proper cannot be determined merely by reference to the dangers they are intended to guard against; these must be weighed against the loss and inconvenience the restrictions may cause, and there is more in that side of the scales than there used to be. If any farmer who relies on artificial insemination is deprived of that service for many weeks it may obviously be a very serious matter for him.

150. Theoretically the danger in permitting artificial insemination in an Infected Area is threefold. A bull at the Artificial Insemination Centre may be incubating the disease and the inseminator may convey it to a farm he visits. Or animals may be incubating the disease on a farm he visits and he may convey it to the Centre. Or animals may be incubating the disease on one farm he visits and he may convey it to another.

151. In practice, effective precautions are possible against conveying infection to and from the Centre. If the semen is taken from bulls outside the Infected Area, any risk there may be from infected semen is no greater inside the Infected Area than outside it, where no restrictions will exist. Nor is there any danger of infected semen even from bulls inside the Infected Area if the semen is deep-frozen and kept until it is certain than the bull from which it was taken was not incubating the disease. The danger of the inseminator taking infection back to the bulls can be avoided if he works from a sub-centre where no bulls are kept. But the danger of his taking infection from one farm to another is not so easily met. It could no doubt be completely avoided if inseminators scrupulously disinfected themselves and their clothes and equipment on leaving every farm they visited. But it is no reflection on those who carry out this duty to say that, in considering what restrictions are necessary on artificial insemination in Infected Areas, account must be taken of the possibility that occasionally disinfection might not be so thorough as it ought to be. This then is the real danger involved in carrying on artificial insemination in an Infected Area.

152. At present artificial insemination in an Infected Area is prohibited except by permission of the Ministry's Veterinary Officer in Charge ; the possible variety of relevant circumstances is too great to permit of any rigid set of rules. But the Ministry are at pains to secure that, as far as possible, their officers take the same course where the circumstances are the same. The normal practice has been described to us as follows.

153. When an outbreak occurs, artificial insemination is suspended in the whole of the Infected Area for seven days. Thereafter it is resumed except at farms within five miles of the infected farm and any farms under observation because they may have been in direct or indirect contact with the disease. After 14 days, only farms within two miles of the infected farm, and farms under observation, are excluded from the service. The farms within two miles of the infected premises and the farms under observation (except where they are contiguous to the infected premises) are released from restrictions after another week. When further outbreaks occur in an Infected Area, restrictions on artificial insemination are not again imposed on the whole of the area but only in rings of five miles radius round the newly infected farms. After a fortnight the size of the rings is reduced to two miles in radius, in which the restriction remains in operation for a further week. That is the general practice. But should the disease break out on several farms in the same neighbourhood, or should it become widespread in the Infected Area or neighbouring Infected Areas as a result of continual outbreaks, artificial insemination may be suspended for several weeks in a part or parts of the Infected Area. The Ministry have instructed their veterinary officers that in such circumstances every case must be considered on its merits. The guiding principles that govern the veterinary officers' decision in complicated outbreaks are these. Have the origins of the outbreaks been established to such an extent as to preclude the likelihood of any of them having arisen from an outbreak that has not been discovered and from which further spread may occur? Have all the contacts, direct and indirect, between the infected farms and other farms been determined so that there is no probability of the disease having been spread to other farms, apart from those already under restrictions because of such contact? Put briefly, it means that the veterinary officers satisfy themselves that the control arrangements have been extended to cover all probable sources of infection before they permit resumption of artificial insemination.

154. As a result of repeated outbreaks there were serious interruptions of the service during the 1951-52 epidemic in parts of Cheshire, Dumfriesshire, Staffordshire, Norfolk, Suffolk and Kent. The National Farmers' Union of England and Wales in their evidence to us said that many cows had to be left uninseminated so long that they were sold for slaughter as unprofitable. They thought that artificial insemination might be allowed more freely if it was done by veterinary surgeons, in view of their professional knowledge and professional discipline. The British Veterinary Association took the same view. The Kent County Agricultural Executive Committee said that artificial insemination was widely used in that county, and that its suspension had been disastrous to the small farmer. They recommended that after the lapse of one week artificial insemination should be allowed on all farms except those within two miles of the Infected Place. The National Cattle Breeders' Association also thought that the restrictions might be relaxed provided that the semen used was kept at sub-centres. So did the Advisory Committee of the Reading Cattle Breeding Centre. The Milk Marketing Board (of England and Wales), who are responsible for 75 per cent. of the artificial insemination centres in those countries, also urged that greater latitude should be permitted. Their proposal was that the service should be

allowed in Infected Areas after two weeks " unless particularly threatening circumstances exist " provided that (*a*) only inseminators with a minimum of one year's field experience were allowed to operate, (*b*) that the semen used came either from Centres in free areas or from a deep-freeze store, and (*c*) that farms within two miles of an Infected Place were not visited. They added that, though several millions of farm visits had been made by inseminators in the past few years, there was not a case on record of a communicable disease of any kind having been taken from one farm to another, and that there were several instances of inseminators who had been on farms when foot-and mouth disease had been in the incubative stage going on to other farms the same day without transferring the infection. This, they said, suggested that the disinfection precautions taken by the Artificial Insemination staff are adequate.

155. Among the witnesses who took the opposite view were the representatives of the Royal Agricultural Society of England and of the Association of State Veterinary Officers. These witnesses thought that it would be dangerous to relax the existing restrictions.

156. No doubt there would be an element of danger in relaxing the existing restrictions. But the question is whether the danger is great enough to warrant the hardship they may inflict. It was put to us by some witnesses that in 1951-52 too much weight was given to the danger and too little to the hardship, and if the guiding principles given in paragraph 153 were strictly adhered to, this may well have been so. The number of farmers affected will be lessened if our recommendation (paragraph 144) for a reduction in the size of the Infected Area is adopted. But even so we think that there may well be a case for some modification of the present practice in prolonged outbreaks. There can be no question about the truth of the statement that no procedure could be devised that would be suitable for all cases. The rule must remain that the question when and where and subject to what conditions artificial insemination may be allowed in an Infected Area lies within the discretion of the veterinary officer. But we recommend that veterinary officers should be encouraged to exercise that discretion in such a way that, when artificial insemination has been suspended for three weeks, it will be the rule rather than the exception—even in prolonged outbreaks—for the service to be resumed everywhere except within two miles of an infected farm, with the stipulation (unless the veterinary officer should think the circumstances make it unnecessary) that the inseminator should work from a sub-centre and that the semen should come from bulls outside the area or should have been deep-frozen for an adequate length of time. The practice should be not to continue the restrictions until it is certain that they can be removed without any danger, but to permit artificial insemination unless it is certain that there would be some definite and special danger in the inseminator's visiting the farm that needs him. We do not think it necessary that, as a measure of precaution, the task of insemination in such circumstances should be limited to veterinary surgeons. We agree with the Milk Marketing Board (of England and Wales) that it should be performed by experienced members of the staffs of the Artificial Insemination Centres, carefully instructed both in the technique of disinfection and in the extreme importance of doing it thoroughly.

Controlled Areas

157. When the Ministry have reason to believe that there has been, or is likely to be, widespread dissemination of the disease, they impose certain restrictions on the movement of animals and on the holding of markets and sales over areas much larger than the Infected Areas. Those larger

areas are called "Controlled Areas". Such restrictions were imposed over very large areas during the 1951-52 epidemic when it became clear that the country was being subjected to a widespread invasion of the disease from the Continent; new centres of infection were occurring, for example, over an area extending from the East Riding of Yorkshire to East Sussex. The length of time during which the restrictions are in operation depends wholly on the extent to which further primary outbreaks occur or the threat of them continues. Sometimes the reason for imposing Controlled Area restrictions is that an infected animal is found to have passed through a market. On these occasions the restrictions are usually of short duration—no longer than is necessary to trace all the animals that may have been in contact with the disease.

158. A few of our witnesses thought that the imposition of Controlled Area restrictions was unnecessary except when the disease was found in stock that was either at a market or had recently passed through one. We have no reason to believe that Controlled Area restrictions have ever been imposed without reasonable justification, and we do not think the Ministry's discretion should be fettered in this way. Some witnesses on the other hand suggested that Controlled Area restrictions should be automatically imposed around all Infected Areas, on the ground that this would often obviate the need for restrictions being later imposed over even larger parts of the country. We do not think that experience bears out the view that this is desirable. On the contrary, we think the right principle is to make the area of precautionary measures as small as is consistent with what experience shows to be the usual range of spread, and to take prompt and drastic action within it.

159. Some of our witnesses criticised the Ministry on the ground that, although Infected Area restrictions become effective immediately they are announced, it is customary to give some 24 hours' notice of an intention to impose Controlled Area restrictions. They argued that giving notice goes far to defeat the object of the restrictions, since during the interval stock can be moved out of the proposed Controlled Area. The Ministry's reply is that the circumstances governing the imposition of Infected Area restrictions and Controlled Area restrictions are very different. The Infected Area restrictions are imposed because disease is known to exist within the area; Controlled Area restrictions are imposed, not when the disease is present, but when there is reason to fear that outbreaks may occur. Moreover, the Infected Area is comparatively small, whereas the Controlled Area can be immense. Indeed, at one time during the 1951-52 epidemic, a Controlled Area covered the whole of England and Wales as well as the part of Scotland south of the Caledonian Canal. The Ministry argue that to impose restrictions over such large areas without prior notice would cause utter confusion, especially at markets and where animals are already on the way to them. We agree.

Movement of susceptible animals into and within Infected and Controlled Areas

160. The existing regulations governing the issue of licences for such movements are contained in a large number of Orders and Amending Orders, presenting a formidable task to anyone who seeks guidance from them. We understand that a revision in the licensing procedure will be necessary when the control of meat and livestock by the Ministry of Food ceases, and we recommend that the Ministry of Agriculture should take this opportunity not only to consolidate the various Orders, but also to consider whether any simplification of them is possible.

161. When the movement of animals is from the area of one local authority to that of another, the licence for it (which is issued by the local authority at the receiving end) has to be countersigned by the local authority at the sending end. The object of counter-signature is to ensure that the animals to be moved are not on premises within two miles of an Infected Place or that they are not on farms under observation because of possible contact with the disease. Many of our witnesses criticised this requirement. They told us that it sometimes involves the farmer in long journeys or causes him inconvenience because it delays the collection of animals and puts him to further expense for feeding them. We see no reason why the local authority issuing the licence should not accept the responsibility for ensuring that the local authority at the sending end have no reason to object to the movement taking place. If that were done, counter-signature would be unnecessary. We recommend that the present procedure should be altered accordingly.

162. We have already referred to the fact that not all local authorities have appointed the police as Inspectors under the Diseases of Animals Act. It was represented to us that, where they have not, the farmer is at a great disadvantage in obtaining a movement licence because the Inspectors are not available at all times, as the police are. The fact that local authority offices are closed at week-ends is a special cause of inconvenience. These witnesses urged that local authorities should always appoint policemen as Inspectors under the Diseases of Animals Act. We agree with them and we recommend accordingly.

163. Some of our witnesses expressed the view that if Inspectors under the Diseases of Animals Act are to carry out their duties efficiently, it is essential that they should be supplied with a handbook of up-to-date instructions. We agree with them. We understand that the existing handbook is obsolete. We recommend that it should be revised and that the Ministry should supply every Inspector under the Act with a copy free of charge.

Arrangements for the control of foot-and-mouth disease in Scotland

164. The Department of Agriculture for Scotland are responsible for all agricultural affairs in that country except those connected with animal diseases. For these the policy is settled in London, but its execution is decentralised to a very large extent. The Department of Agriculture for Scotland are consulted about all matters connected with animal diseases that are of particular importance to Scotland, and close liaison is maintained through one of the Ministry's Deputy Chief Veterinary Officers who is stationed in Edinburgh.

165. The question has often been mooted whether Scotland ought not to have a separate Veterinary Service. Our witnesses were divided in their opinion about this. The Department of Agriculture for Scotland said that, although they thought a case for a separate Service could hardly be made out on the grounds of foot-and-mouth disease alone, there was, in their opinion, a strong case for one for the purpose of livestock improvement. They agreed that the need for a common policy in England and Scotland for dealing with foot-and-mouth disease was a strong argument for maintaining the present system of unified control, but thought that a separate Veterinary Service might result in more attention being paid to Scottish views, and that, on balance, a separate Service would be advantageous to Scotland. The National Farmers' Union of Scotland said there were several animal health questions of particular interest to Scotland which seemed to make a separate Service desirable, although they too expressed the opinion that such a Service could not be justified on the grounds of foot-and-mouth

disease alone. The Association of County Councils in Scotland thought that a separate Service would result in greater speed and efficiency in dealing with outbreaks of the disease in Scotland, that Scottish interests would receive greater consideration, and that advantage could be taken of local knowledge. On the other hand, the Ministry, the Royal Highland and Agricultural Society, the Counties of Cities Association, the Blackface Sheep Breeders' Association and the Livestock Export Group favoured the continuation of the present system of unified control. But two of them added reservations: the Royal Highland and Agricultural Society thought that more authority should be delegated to the Ministry's Edinburgh office, and the Blackface Sheep Breeders' Association that greater attention should be given to Scottish interests.

166. Disease does not recognise geographical boundaries; an Infected or Controlled Area may lie—and sometimes has lain—partly on one side of the Scottish Border and partly on the other. The vital need is for prompt action on uniform lines, and we are satisfied that this is more likely to be secured by unified control—with suitable delegation of authority—than by dual control, with the occasions it would inevitably present for consultation and possibly argument. Even of those witnesses who were in favour of separation, most conceded that it would not be justified merely on the ground that it would make for greater efficiency in dealing with foot-and-mouth disease, and that is the only consideration we are concerned with.

167. One argument put forward in favour of separation was that it would enable Scotland to close the Border against the movement of animals when outbreaks of foot-and-mouth disease occur in England. Some of our Scottish witnesses thought that the spread of the disease to their country might be prevented by timely action of this kind, and they suggested that, even though the Services were separate, the Scottish authorities should have power to take it without prior consultation with the Ministry. Other Scottish witnesses saw no good reason for closing the Border when outbreaks occurred in England except to animals from Infected or Controlled Areas (whose movement is already prohibited), especially in view of the importance of the trade in calves from the south of England to Scotland. The main reason underlying the suggestion that this special power should be given is that there might be circumstances in which, for the sake of the Scottish export trade, it would be useful to be able to assure overseas customers that there was no foot-and-mouth disease in Scotland and no susceptible animals were being admitted from any country where it was present. But we do not think that this consideration justifies a breach in the principle of unified control. Under the existing law and regulations movement of cattle can be stopped between any part of Great Britain and any other, and if at any time during the presence of the disease in England the Secretary of State for Scotland were convinced that, for reasons other than the immediate necessities of the campaign, the importation of susceptible animals from England to Scotland ought to be stopped, it seems to us proper that so important a step should be a matter of agreement between him and the Minister of Agriculture.

Other causes of spread

Milk distribution

168. The collection of milk from infected premises is, of course, prohibited, but it continues from other farms in the Infected Area. There is a danger that some of it may come from cows in the incubative stage of the disease at a farm where no symptoms have yet shown themselves. If such milk is fed to susceptible animals, it is almost certain they will contract the disease. Not only was the feeding of infected milk to calves in transit at Crewe the cause

of the disease being spread to Scotland during the 1951-52 epidemic, but also infected milk from another source that was fed to calves was responsible for the disease being spread from Cheshire to Derbyshire (see paragraph 24 of Appendix V). The disastrous results of the Crewe incident led several of our witnesses to suggest that the feeding of raw milk to calves in transit through an Infected Area should be prohibited. But that would not wholly meet the danger; in the Crewe episode the infected milk was distributed before the Infected Area was proclaimed. Calves are a particularly dangerous source of the spread of the disease, both because they may not show the usual symptoms and because the trade in them involves their travelling long distances and their dispersal over wide areas. We think that special precautions are called for against this special risk, and we recommend that the feeding of milk to calves in transit should be prohibited at all times. Calves are ordinarily sent in trucks attached to passenger trains and do not spend a long enough time on the journey to need anything more than water. The watering of animals in transit at least once in every 24 hours is already obligatory under the Diseases of Animals Act.

169. Other dangers arise from the collection of milk from cows in the incubative stage of the disease. The churns, the churn washings, the waste milk and the whey may be contaminated. In the opinion of our official witnesses, churn washings and waste milk were responsible for several of the outbreaks that occurred during the 1951-52 epidemic (paragraphs 23 and 25 of Appendix V). We think it would be reasonable to provide that when dairies (or cheese factories) receive milk supplies from Infected Areas, no churn washings or waste milk should be allowed to be taken away from the premises unless they are heat-treated sufficiently to destroy the virus. We recommend accordingly.

170. Some of the outbreaks in 1952 in Staffordshire are thought to have been attributable to infected milk churns (paragraph 23 of Appendix V). Under the Milk and Dairies Regulations, every dairy farmer or distributor is required to ensure that churns are in a thorough state of cleanliness immediately before being used for the carriage of milk and before being returned empty. But thorough cleanliness as prescribed by the Milk and Dairies Regulations (which are concerned with public health) does not necessarily mean that the exteriors of the churns would be free from the virus of foot-and-mouth disease. That can only be ensured by sterilisation, and all stock-owners are advised by the Ministry to sterilise their churns, particularly the exteriors and the handles, "immediately they are received from the distributors". But this has not been made compulsory because of the difficulty of enforcing such a regulation. There would no doubt be less difficulty in enforcing it at the distributing end, and we think this ought to be done, but that would still leave the danger of the churns being contaminated on the way back to the farm. Sterilisation at the farm is still desirable, and we recommend that all possible publicity should be given to the Ministry's advice, particularly to farmers in Infected Areas and to those sending milk into Infected Areas. There are moreover two steps that could be taken to reduce the risk of churns in transit becoming infected. We recommend that in Infected Areas milk lorries should be prohibited from entering farms and that all farmers should put their churns on loading platforms on the roads. We were told that during the 1951-52 epidemic this was done on their own initiative by many farmers who ordinarily load their churns on the farm. The other step we think might be taken is one suggested to us by the Milk Marketing Board (of England and Wales), namely that separate lorries

should be used in seriously infected areas for the conveyance of empty and full churns. We presume the Board have satisfied themselves that this would be practicable without unreasonable expense, and we think it would be a wise precaution.

People and animals

171. We heard much of the spread of the disease by people and animals—by the visits of farmers, their families and employees to neighbouring farms, by countryside ramblers and by roving dogs—and indeed these are the most natural and obvious ways by which infection may be disseminated. But such dangers as these cannot be met by rules and prohibitions unless the danger is immediate and palpable, as it is in the case of movement off and onto the Infected Place itself. This is prohibited except by permission. There are also regulations about keeping dogs under control, but these are difficult to enforce. It seems to us clear that, in general, the only effective protection against risks such as these is an informed public opinion, a subject to which we shall return (paragraphs 198-201). But the fact that some risk must be run if normal life is to go on is no reason for permitting exceptional risks to be created in ways that are preventible. It was represented to us that the holding of point-to-point races in Infected Areas ought to be prohibited on the ground that the concentration in an Infected Area of a large number of people, many of them from widely distant places, must involve risk of spreading the disease. We agree. "Hunting, and the racing or coursing, or the training for racing or coursing, of hounds or dogs" is already prohibited in Infected Areas. We recommend that this prohibition should be extended to include point-to-point races. We deal with Agricultural Shows separately in paragraph 210.

172. We understand also that the Ministry have represented to the War Office that troop manoeuvres in Infected Areas are a source of danger. Several of our witnesses made the same point. We agree with them. The War Office have taken steps to ensure that, generally, troops will not go within five miles of an infected farm when on manoeuvres. They have said however that occasions might arise when it would be necessary for troops to operate as near as two miles from infected premises, but that no intrusion would be made into the two-mile area without consulting the Ministry. We do not think there can be any circumstances in which troops on manoeuvres ought to be allowed to go within two miles of infected premises, and we recommend accordingly.

Slaughterhouse offal

173. We have been informed that unsterilised slaughterhouse offal is sometimes spread on agricultural land as a fertiliser. This seems to us to be not only unhygienic and offensive, but also a possible source of the spread of foot-and-mouth disease and other diseases, since the offal attracts birds, vermin and other possible vehicles of infection. We recommend that the practice should be prohibited.

Cattle Dealers

174. The increase in the speed and range of motor transport in recent years has resulted in cattle dealers moving their animals more quickly and over wider areas than they used to do. We understand that it is now not unusual for dealers' cattle to pass through as many as four widely separated markets in as many days. This obviously increases the danger of spreading

disease and the difficulty of tracing contacts. Both the Royal College of Veterinary Surgeons and the Association of State Veterinary Officers thought that steps ought to be taken to restrict these movements by requiring that animals should be detained for some days immediately after they have been exposed for sale. This is already done in the case of Irish cattle. Animals imported from Eire and Northern Ireland must be detained at their destination for at least 6 days; and may only pass through one market en route to that destination. The cattle are marked in a distinctive manner on landing so that they can be identified afterwards. The reason for this regulation is not that Irish cattle are specially likely to bring foot-and-mouth disease with them but that, at the time when it was imposed, they were specially likely to be a means of spreading it owing to the practice of moving the animals through many markets in quick succession. The danger used to be peculiar to Irish cattle, but widespread movements of the same kind are now a fairly common feature of cattle-dealing in Great Britain, and there is no longer any logical reason for confining the regulation to Irish cattle. There is however the practical reason that the regulation is difficult to enforce unless the cattle can be identified. This difficulty will be removed when the Ministry's Tuberculosis Eradication Scheme has been completed, and all cattle are attested and ear-marked. We recommend that the Ministry should then consider the making of a regulation to the effect that, after every exposure for sale, cattle should be detained at their next destination for 6 days (whether they have been sold or not) unless they are moved to a slaughterhouse.

175. Several witnesses recommended that dealers should be licensed in order that their activities might be more easily controlled. Allegations were made that some dealers were prone to break the Ministry's regulations about the movement of susceptible animals, but no evidence was produced to justify our supporting the proposal for licensing.

Importation of English calves to Scotland

176. We have related the disastrous consequences of infected calves being sent from England to Scotland in 1952. This experience led some of our Scottish witnesses to make suggestions for controlling the large traffic in calves that is now carried on between the two countries. The Royal Highland and Agricultural Society told us that some of their members thought that arrangements should be made for calves sent to Scotland to be licensed from the farm of origin to the farm of destination. They also recommended that the animals should be detained on the destination farm for 28 days in order to prevent cattle dealers from passing them through several markets in quick succession. Other members said that the Border should be closed to calves when there was foot-and-mouth disease in England. The Counties of Cities Association, on the other hand, were of opinion there was little to be gained from a licensing system and that the large amount of work it would entail could not be justified. We have already stated our conclusions on the questions of the compulsory detention of purchased cattle on the premises of the purchaser (paragraph 174), of the closing of the Border (paragraph 167) and of the feeding of milk to calves in transit (paragraph 168). If our recommendations are eventually carried out the danger of infection from this traffic will be much reduced, and we agree with the Counties of Cities Association that to subject it to licensing would not justify the work that doing so would entail.

Disinfection

Premises

177. Disinfection of infected farms is usually carried out in this country by unskilled labour temporarily enlisted locally or by employees of the farm concerned, using stirrup pumps. There is no doubt that our method is amateurish compared with those of some foreign countries: in several of these power-equipment is used and in some it is operated by trained squads. It is obviously easier, quicker and more economic to make a thorough job of disinfection with a power pump than with a hand one, and we think power-equipment should be used. We have not thought it necessary to go into the question closely enough to justify our making any detailed proposal, but we recommend that the Ministry of Agriculture should consider how our methods might be improved. Possibly local authorities might undertake the duty of providing equipment and trained staff from their fire brigades and cleansing departments.

Vehicles

178. The Road Haulage Association told us that, although there were few markets where there were no facilities for cleansing vehicles, there were many where the facilities were inadequate. The driver of any vehicle used for the conveyance of animals by road has a statutory duty to cleanse and disinfect it after each load of animals has been discharged. This applies at all times and not only when outbreaks of foot-and-mouth disease occur. It will be seen from our account of the 1951-52 epidemic in Great Britain (paragraph 27 of Appendix V) that a contaminated cattle transport lorry was the cause of 22 outbreaks. We recommend that all market authorities should be obliged to provide proper facilities, including piped water, for cleansing and disinfecting lorries.

Slaughter

Extent

179. The decision what animals should be slaughtered as "contacts" is left to the discretion of the Ministry's veterinary officer in every case. We have already described (paragraph 51) the considerations that guide him in deciding whether the contact is such that the animals must be slaughtered at once or can be kept under observation without undue risk. On the whole our witnesses were not disposed to criticise the way in which these officers exercise their discretion. But there were exceptions. Some represented that the policy was applied too drastically and sometimes inconsistently. Others advocated its enforcement even more rigorously. A few thought all slaughter of contact animals to be unnecessary.

180. In view of the unparalleled infectivity of foot-and-mouth disease we have no doubt that an effective stamping-out policy must include the slaughter of "contacts". We have also no doubt that it is quite impossible to formulate any precise dividing line between the type of exposure to infection that necessitates slaughter and the type that justifies keeping an animal under observation. Each case must be decided on its merits by the man on the spot. Our evidence certainly does not justify any general conclusion that these difficult decisions are made either with excessive caution or with too great a readiness to take risks. No doubt there may be inconsistencies. But that is inevitable, and we are confident that the Ministry will continue to do what they can, by central guidance, to reduce them to a minimum.

Place

181. In the foreign countries we visited where stamping-out is the policy, we found that slaughter is not always carried out on the farm

premises. In some—Norway for instance—this is done. But in others all the animals on an infected farm are taken to abattoirs for slaughter; in others again the infected animals only are slaughtered on the farm, and the contacts taken to abattoirs. This led us to consider the possibility of ending or mitigating in this country the unpleasant and distressing practice of slaughter on the farm.

182. But we felt bound to reject unhesitatingly the idea that, in the circumstances of this country, animals actually suffering from the disease should be moved off the farm. The risk would be far too great to be justified by a gain that might be characterised as merely sentimental. To send the contact animals to abattoirs would not involve so obvious a risk, but elaborate precautions would have to be taken against the possibility that they were incubating the disease. These would have to include major constructional alterations at many of the abattoirs, as well as specially built sealed lorries for the transport of the animals to prevent urine and excreta, possibly infected, from being spilled during the journey. And strict veterinary supervision would be necessary at the abattoirs. In all the circumstances we have regretfully come to the conclusion that the practice of slaughtering infected and contact animals on the farm must continue.

Disposal of carcases

183. The Departmental Committee of 1924 observed

> "Opinions on the merits of cremation as against burial are by no means unanimous, the objections to the former method being mainly on the grounds of moral effect and the possible spread of disease by particles carried with the smoke. The first is a very powerful argument in the circumstances of the present outbreak, especially in Cheshire, but there seems little veterinary support in favour of the second objection. It is true that disease has time after time appeared in the direction in which the smoke from cremation pits has been blowing, but as the virus can be air borne it is more probable that this was what happened, the drifting of the smoke being merely an indication of the direction of the wind. It is impossible to dogmatise on this point of the disposal of carcases, inasmuch as conditions vary so much on the different infected places. Opinion generally in agricultural circles appears to favour burial, and we content ourselves with the recommendation that this should be the course where practicable, inasmuch as it requires less labour for its carrying out, and involves less traffic to and from the premises whilst operations are going on.
>
> The decision in any particular case must be left to the judgment of the Inspector in charge in the light of local conditions."

We understand, however, that it was the general practice up to the outbreak of the last war to dispose of the carcases by burning. It was when the wartime "black-out" arrangements precluded burning that burial was adopted, and it has been continued up to the present time. The shortage of fuel has no doubt been regarded as a strong reason for maintaining this method.*

184. Our witnesses were almost unanimous in thinking that cremation is preferable to burial. Their main reason was that the carcases should be disposed of as quickly as possible to prevent the virus being spread by birds and vermin that might have contact with the slaughtered animals. It appears also that there have been occasional delays in disposing of carcases

* About 6 tons of coal, ½ ton of wood, a truss of straw and 2 gallons of paraffin are required to cremate 50 cattle.

because of the difficulty in getting suitable excavating machinery or because strata of rock are close to the surface of the ground. Although the Ministry's instructions provide that the carcases shall be covered with six feet of earth, it was also suggested to us that vermin might get into the burial pits and spread the disease.

185. Speedy and effective disposal of carcases is clearly most important, and we agree with the large majority of our witnesses that, since cremation is the best way of securing this, its advantages should be regarded as outweighing its unpleasantness. We cannot express any opinion on the question how far, in present conditions, the importance of conserving fuel rules out the resumption of this practice, but we recommend that, subject to this, it should once more be adopted as the general method. It should certainly be used if any difficulties in burial are likely to arise.

Salvage

186. Before considering the question of salvage, it may be useful to explain rather more fully than we did in paragraph 51 the reasons underlying the slaughter of apparently healthy animals, for it is not unnatural that criticisms of the practice as irrational should sometimes be heard. The fact is that there are three stages in an attack of the disease. The first, when infection has taken place but no reaction to it has so far occurred; the second, when the virus begins to multiply and a rise in temperature generally takes place; and the third, when the animal begins to show other clinical signs such as salivation or lameness, and lesions usually become apparent. If an animal that has been in contact with the disease is slaughtered in the first stage, when it is apparently healthy, the likelihood of the carcase being a source of danger to other stock is so remote as to be negligible. But if slaughter does not take place until the second stage is reached, although the animal may appear healthy, the virus will already have begun to multiply and there will be danger of its being disseminated. It would be impossible to devise rules to ensure that animals slaughtered as contacts included only those actually infected.

187. Up to 1922, it was usual to salvage the carcases of apparently healthy contact animals. During the severe epidemic of 1923–24, this practice had to be abandoned in Cheshire to enable the veterinary staff to devote all their attention to actually grappling with the outbreaks. The Departmental Committee of 1924 said that the evidence they received convinced them that "less rigid insistence on salvage would have led to such substantial results in the more speedy eradication of the disease as to far outweigh any financial loss which might have resulted from the reduced sale of carcases". They recommended that it should be left to the discretion of the veterinary officer in charge to decide whether salvage should be undertaken. In 1927 salvage was abandoned entirely; but in 1940, because of the shortage of meat, veterinary officers were instructed to salvage unless they thought it involved danger; and that is the position at present.

188. On the whole our witnesses were against salvage. There were some important exceptions, but even these showed hesitancy in advocating its continuance. The Royal College of Veterinary Surgeons considered that the salvage of apparently healthy animals should be continued as at present, subject to rigorous enforcement of the rules about disinfection of those engaged in it. But they thought that it was often undesirable, and emphasised the dangers arising from the impossibility of being certain that the animal to be salvaged was not infected, and from the presence of butchers on the infected farm. The Royal Agricultural Society of England, the Milk Marketing Board (of England and Wales) and the County Councils' Associa-

tion also thought that salvage should be continued, subject to the most rigorous safeguards. The National Farmers' Union of England and Wales felt very strongly about the danger of salvaging, and they hoped the practice would be stopped when adequate meat supplies became available. With these exceptions, our witnesses advocated the immediate discontinuance of all salvage, because the danger was too great. Many of them thought it was almost impossible to ensure that the butchers, their clothes, their equipment and their lorries were properly disinfected. They were also concerned about the risk of the disease being spread by scraps of meat from salvaged carcases finding their way to the swill tub. As we have recorded, the long and costly series of outbreaks that occurred in Dumfriesshire and the north-west of England in 1952 was attributed by the Ministry to swill that became contaminated by the inclusion of scraps of meat from the carcases of apparently healthy animals salvaged from the outbreaks in Wigtownshire (see paragraph 140). It was also argued that the abandonment of salvage would facilitate the eradication of the disease, since slaughter and disinfection inevitably take longer when salvage is carried out. Some witnesses contended that salvage is illogical: if contact animals are considered to be so dangerous that they must be slaughtered, it must also be dangerous to salvage their carcases. It was also said that the presence of butchers and their lorries on infected farms was inconsistent with the stringent regulations that restrict movement onto or off such premises, and that this militated against the strict observance of those regulations because it resulted in some farmers doubting the need for them.

189. These representations were reinforced by the argument that salvage does not make any significant contribution to the country's supply of meat. This seems to be borne out by the facts. The Ministry of Food told us that the value of the meat salvaged during the fifteen months ended November, 1952—and that covers the whole period of the last epidemic in this country—was equivalent to no more than 2d. per head of the population. If that is all the contribution that salvaged carcases made to the nation's food supply during an epidemic, the contribution in normal times must be so small that it does not seem to justify the risk that it undoubtedly involves. We think the decision taken in 1927 was right, and we recommend that salvage should be discontinued.

Publicity about outbreaks of foot-and-mouth disease

190. The success of any system for controlling the spread of foot-and-mouth disease must depend to a large extent on immediate and effective publicity about the occurrence of outbreaks, the restrictions imposed and the areas affected by them. The Ministry use the B.B.C. and the Press for this purpose.

191. Various suggestions were made to us for improving the methods of publicity. Some witnesses for instance thought it would be better if broadcast announcements about the location of new outbreaks were made at fixed times. After taking evidence from a representative of the B.B.C. we do not think that the advantages to be gained by this would warrant the difficulties that it would involve. Having regard to the multifarious demands on the B.B.C. for broadcasting time, we are of the opinion that the present arrangements for broadcasting information about foot-and-mouth disease are quite satisfactory and that the willing co-operation of the B.B.C. with the Ministry on this question leaves nothing to be desired.

192. The national Press do not always report outbreaks of foot-and-mouth disease. Indeed they cannot be expected to. It is a matter mainly of local interest, and the local papers are the most important medium of

publicity. The Ministry always use them, but promptness is all-important, and we think there is some room for improvement in the machinery of contact between the Ministry and the local Press. We understand that a recent decision to work through the Central Office of Information is proving of value, and it is important that the appropriate Regional Officers of the Central Office of Information should always keep in close touch with the Ministry's local veterinary officers when outbreaks occur.

193. It is not the Ministry's practice at present to notify the B.B.C. or the Press of new outbreaks in an Infected Area even though they mean an extension of the Infected Area. Although information about any extension of Infected Areas is published by the local authorities in the local papers, we nevertheless think it desirable that the Ministry should give the Press details about both these types of cases, and we recommend accordingly. But we do not think it would be reasonable to expect the B.B.C. to announce them.

194. Neither the B.B.C. nor the Press are notified when Infected Area restrictions are withdrawn. Some of our witnesses thought that omission to announce their withdrawal might be responsible for the exaggerated reports that sometimes appear in the foreign Press about foot-and-mouth disease in this country. They feared that such reports were harmful to our cattle export trade. However that may be, it seems to us proper that the cessation of restrictions should be announced in the same way as their imposition, and we recommend that both the B.B.C. and the Press should be notified of the withdrawal of Infected Area restrictions.

195. It is the practice in Norway to issue Press reports about the disease situation in Sweden and Denmark, in order to keep Norwegian farmers informed in advance of the likelihood of the disease spreading to their country. Several of our witnesses suggested that, for the same reason, publicity should be given to any exceptional building-up of infection on the other side of the North Sea or English Channel. We agree with them and we recommend that on such occasions the information should be given to the B.B.C. and the Press.

196. The B.B.C. broadcasts do not define Infected Areas in detail. The announcement is usually to the effect that an outbreak has occurred at a specified place and that the restrictions apply to an area of approximately 15 miles radius around it. Press reports do not usually give much more information than this. It has been represented to us that, unless all farmers in an Infected Area are notified individually, there is a danger that they may not know that they are subject to restrictions and that they may inadvertently contravene them. We recognise the difficulties of individual notification of farmers. It could only be done by the police. But individual notification seems to us important, and, reluctant as we are to add to the onerous duties of the police, we feel bound to recommend that they should assume this responsibility.

197. Many of our witnesses stressed the desirability of giving early information to veterinary surgeons when outbreaks occur in their locality. We agree that, for obvious reasons, they ought to be told at once, and we recommend that veterinary surgeons known to be practising in an Infected Area should be notified by the Ministry by telephone, or by telegram, of all the outbreaks that occur in that Area.

Education about foot-and-mouth disease

(*a*) Farmers

198. All our witnesses, both in Great Britain and abroad, agreed that it was essential to educate farmers about foot-and-mouth disease, but there

was a marked cleavage of opinion on the desirability of giving them detailed information about the symptoms. Generally, the expert witnesses were opposed to this on the ground that it might lead farmers to delay reporting outbreaks until their animals showed the symptoms that had been described, and that they would not report atypical cases. This is the official view. On the other hand, organisations connected with the farming industry were in favour of farmers being given full information about all the symptoms. They argued that this would be more likely to result in prompt identification of the disease and early reporting. A farmer witness told us that, in his opinion, the reticence of the Ministry's present advisory leaflet about the typical symptoms was calculated to cause uncertainty that might produce dangerous delays in reporting. Many of our witnesses expressed the opinion that most of the cases of delayed reporting during the 1951–52 epidemic were not wilful but the result of ignorance about the symptoms. We do not think the danger of farmers tending to rely too much on their own diagnosis if they were told all the symptoms of the disease is sufficiently weighty to offset the advantages that we believe would accrue from their being fully informed. Indeed it seems to us that they have a right to know: in a matter such as this it is wrong in principle for officials to be chary of imparting knowledge lest it should be misused. We recommend that the Ministry should give farmers full information about the symptoms of the disease, but that they should also stress the fact that the symptoms may be obscure or atypical and that farmers are required by law to report even a suspicion of the disease.

199. In some of the European countries we visited we found that much was done to educate farmers about foot-and-mouth disease by way of films, broadcast talks, articles in the local Press, lectures to agricultural organisations, posters and pamphlets. In Switzerland the nature and the control of the disease are a compulsory subject in all agricultural schools, and in some other European countries education of the farmer on this subject is a continuous process. The case for action of this sort is of course less urgent in this country than in countries that are trying to reduce the ravages of an endemic disease. But we think that there is room for increased publicity about the disease in the rural areas in this country, and we are glad to learn that the Ministry are to make a film for exhibition to farmers. We recommend that they should also consider the practice of continuous education of farmers that has been adopted in some European countries.

(*b*) The general public

200. Many of our witnesses recommended that the public generally should be kept continuously informed about the dangers of spreading the disease. It is very important that they should know of the danger, but a continuous campaign to inculcate that knowledge would be likely to defeat its own object. The public are more likely to heed warnings if these are given when and where the danger is present, and we think more might be done in this direction that is done now. For instance a striking poster (in the style of that about the Colorado beetle) might be prominently and widely displayed in and around Infected Areas. Stock magazine articles should always be available to be syndicated, through the Regional Officers of the Central Office of Information, to the local Press. A film illustrating the dangers of spreading the disease and the immense losses it can cause might also be available for exhibition in those localities.

(*c*) Veterinary Surgeons

201. Many witnesses emphasised the need for doing everything possible to ensure that veterinary surgeons in private practice will recognise the disease

when they see it. The importance of this is indeed obvious. It was sharply brought into prominence during the 1951-52 epidemic in Great Britain when, on several occasions, veterinary surgeons in private practice failed to suspect the existence of the disease in spite of more than one examination of infected animals (see Appendix V). Foot-and-mouth disease is included in the curriculum of all veterinary students, but the comparative rarity of the disease in this country, the need for restricting the number of people having access to infected animals and the practice of immediate slaughter preclude most veterinary surgeons from having practical experience of it. We understand that the Ministry are doing something to meet this need by making a film strip, with the help of the Research Institute at Pirbright, for exhibition to private veterinary surgeons and veterinary students. We hope that in this and other ways the Ministry will continue to make every effort to overcome the handicap from which the veterinary surgeon in private practice at present suffers by lack of experience of the disease. These might include the use of coloured films, the provision of suitably prepared post-mortem specimens and the periodical circulation of bulletins giving up-to-date technical information about the disease.

Reporting the disease

The duty

202. Prompt reporting is of paramount importance to any system of controlling the disease; the story of the 1951–52 epidemic shows that clearly enough. We have dealt elsewhere with delays arising from a failure by the farmer to suspect the disease (paragraph 198) or by a veterinary surgeon to recognise it (paragraph 201). In the following paragraphs we are concerned only with deliberate neglect by a farmer to carry out his statutory obligation. Our first comment must be that we think the obligation might usefully be widened. The present law declares that the existence or suspected existence of the disease must be reported. That, no doubt, in ordinary circumstances, is the most that can be required of a farmer. But diagnosis in the early stages may be so difficult (sometimes, as we have seen, baffling even veterinary surgeons), and the chances that a sick animal may prove to have foot-and-mouth disease are so greatly increased when the disease is in the neighbourhood, that we think it would be a reasonable and indeed an essential precaution if farmers in Infected Areas were required to report *any* illness in susceptible animals (other than hill sheep). Probably most do so already. We recommend accordingly.

The penalty

203. The present maximum penalties that may be imposed by a Court on conviction of failure to notify foot-and-mouth disease with all practicable speed are a fine of £50 or, where the offence is committed with respect to more than 10 animals, £5 for each animal. When a second offence is committed within a period of 12 months, the punishment for the second offence may be up to one month's imprisonment instead of a fine. In addition to these penalties the Ministry have power to withhold, either wholly or partially, the compensation normally payable for any animals in respect of which the offence was committed. Our witnesses held different views about these penalties. Some thought they were adequate, some that they should be increased, and some that the matter was of small importance since the fear of punishment had little influence on the speed of reporting. Some again considered that more drastic use should be made of the power to withhold compensation, and some that this penalty was undesirable in principle.

204. To dispose of the last point first, we are in emphatic agreement with those who criticised the existence of the power of the Minister to withhold compensation. If the law were that anyone convicted of this offence automatically lost his right to compensation, that would be unobjectionable in principle, though we do not think it would be right in practice: the punishment might be excessive. But it seems to us indefensible that there should be a power in the Executive, at their discretion, and without any appeal, to increase the penalty inflicted by a Court on someone convicted of a criminal offence. We recommend that the power should never be used, and should be abrogated at the first convenient opportunity.

205. The maximum fines that the Court can impose were raised to their existing levels in 1927. If they were right then, they should obviously be increased now so as to adjust them to present-day money values. But we do not think they were right in 1927. The public mischief that can follow neglect of prompt reporting is so serious that we cannot believe the present maximum statutory penalties ever to have properly reflected the gravity of the offence. Something more than a mere adjustment seems to us to be called for, and we recommend that the maximum fines should be increased to £500, or where the offence is committed with respect to more than ten animals, £50 for each animal.

206. No one has been able to tell us why the punishment of imprisonment for a second offence is restricted to one committed within 12 months. We recommend that this limitation should be abolished.

Insurance against foot-and-mouth disease

207. Some Insurance Companies do not issue new policies in respect of animals that are in Infected Areas at the time of application. Others stipulate what is known as a " waiting period ", which means that the policies do not become effective until some 8–14 days after the proposal has been accepted. Although none of our witnesses knew of any case where reporting of the disease had been delayed because of the existence of an insurance policy that prescribed a " waiting period " there was, nevertheless, almost unanimous agreement that such policies were a temptation to delay reporting and therefore undesirable. We agree. At least one Insurance Company has recently abolished the " waiting period " and we hope that the others will see their way to doing the same.

Compensation

The farmer

208. The " compensation " paid by the Ministry is the market value of the animals assessed by a professionally qualified valuer. No more than this (sometimes less) is paid in other countries we visited where stamping-out is carried out. Witnesses in this country who had lost cattle in this way paid almost unanimous testimony to the fairness with which they had been treated. It is true, as many witnesses pointed out, that these payments do not cover the consequential losses that farmers incur as a result of outbreaks of foot-and-mouth disease. But, for reasons given more fully in the next paragraph, we do not think it reasonable to expect the State to make good consequential losses. " Compensation " is perhaps a misleading term. What the farmer gets is the price the Ministry pay for purchasing the animals so that they may be slaughtered.

The farm worker

209. Representations on this subject were made to us by the National Union of Agricultural Workers and the Transport and General Workers' Union. They said that overtime among stockmen is now so usual that it is

regarded as a source of their normal income on which their standard of living is based. The cessation, when outbreaks of the disease occur, reduces their standard of living; and it was argued that, as the farmer is compensated for the slaughter of his animals, the stockman should be compensated for the loss of overtime earnings. But the loss suffered by stockmen when outbreaks of foot-and-mouth disease occur is a consequential one, and consequential losses are also incurred not only by the farmer but by numerous other people connected with the various branches of the livestock industry. No compensation is paid to any of them. Indeed, if the principle of compensation for consequential losses were accepted, it would be almost impossible to define the numerous classes of people who would have some claim for its being applied to them. Foot-and-mouth disease is one of the hazards of farming, and much as we sympathise with the stockmen on this point, we cannot recommend treating them exceptionally.

Agricultural Shows

210. An agricultural show, which congregates a large number of susceptible animals from different parts of the country and then scatters them again, can clearly be a most potent means of disseminating infection when foot-and-mouth disease is about. The degree of danger will depend on where the show is to be, where the cattle come from, and where the disease is occurring. There is an absolute prohibition of the exhibition of cloven-hoofed animals at shows within Infected Areas. Elsewhere the Ministry have power to prohibit their exhibition. The exercise of this last power has proved not free from difficulty. During the 1951-52 epidemic it was the practice of the Show Societies to ask the advice of the Ministry, and this was usually given three or four weeks before the date of the show. It was always given subject to the understanding that it might have to be reversed if circumstances changed. When the Ministry advised cancellation, the advice was always taken, and the Society shouldered the responsibility for the decision. The power to prohibit never had to be used. Some of the representatives of the Societies who gave evidence before us thought that this put an unreasonable burden on them: the Ministry, they said, ought to accept responsibility by giving directions and not confine themselves to advice, and ought to make up their minds in good time so as to minimise the financial loss that cancellation must cause. We sympathise with this point of view, and should like to pay a tribute to the spirit of co-operation that the Societies showed throughout the difficult times of 1951-52. But we do not see how the Ministry can do anything other than what they did then. Whether it is safe to hold a show depends on circumstances that cannot be foreseen: only at the last moment could the Ministry take an irreversible decision in favour of its taking place. They must retain up to then the power to prohibit the exhibition of cloven-hoofed classes, even though they may have previously advised that it would be safe to include them. Certain witnesses suggested that at the beginning of each show season the Ministry ought to make a final decision about each projected show, so that the Societies could know how they stood. But a decision taken in advance, if it were to be final, could only be that no susceptible animals could be accepted at any show. We see no way in which the Show Societies can escape the responsibility for an eventual decision except by refusing to take the Ministry's advice when they counsel cancellation, and forcing them to make an Order. The whole tenor of their evidence convinces us that they would be most reluctant to take this way of shedding their responsibility, and we have no doubt that they will continue to shoulder it, with the help of the best advice that the Ministry can give them in the light of the circumstances existing at the time.

The Ministry's Veterinary Staff

211. Certain representations were made to us about the conditions of service of the Ministry's veterinary staff. It was said that those conditions were not sufficiently attractive to secure an adequate supply of suitable candidates, and also that it would make for efficiency if the temporary staff were reduced and the permanent establishment increased. To our mind the evidence we have taken shows conclusively that the very heavy duties imposed on the Ministry's veterinary staff by the epidemic of 1951-52 were performed with a zeal and efficiency deserving the highest praise. We have no evidence that there is here any weakness that calls for remedy in the system of controlling outbreaks of foot-and-mouth disease. That being so, we do not think it would be proper for us to regard the conditions of service of the veterinary staff of the Ministry—who have many other things to do besides those we are concerned with—as falling within our Terms of Reference.

212. We would however permit ourselves two observations on this subject. One is that the arguments submitted to us for the reduction of the temporary staff and an increase in the permanent seemed to us to deserve the careful consideration of the Ministry. The other is that we should like to emphasise the immense responsibility placed on the Ministry's veterinary officer in charge of an area where outbreaks of foot-and-mouth disease are occurring. He must make instant decisions to deal with a situation that may change from day to day or from hour to hour; he must steer a middle course between undue caution that may cause unnecessary hardship to the farming community and an undue readiness to take risks that may have disastrous consequences; and he must rely on his own judgement. One or two witnesses were so much impressed by the magnitude of this responsibility that they suggested that a panel should be drawn up of men of exceptionally high standing and proved ability in other walks of life from whom a Commissioner could be chosen to be given charge of an area in which an epidemic takes place. We do not agree with this suggestion; we think that the officer in command should continue to be chosen from the Ministry's veterinary staff. But we trust that those who decide the conditions of service of that staff will bear in mind the need to make them such as will continue to attract men of a calibre adequate to the discharge of these exacting duties.

CHAPTER VI

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

1. Seriousness of foot-and-mouth disease

The disease would rapidly establish itself as endemic in any country that failed to take energetic and rigorous measures to prevent it. If it were to do so in this country the result would be a national calamity (paragraph 5).

2. Introduction of the disease into this country

(1) *By birds*

(*a*) The case against the starling is formidable but it has not been proved (paragraph 18).

(*b*) Seagulls may be as serious a danger as starlings (paragraph 20).

(*c*) There seems small reason to suspect racing pigeons (paragraph 22).

(2) *By the wind*

It seems possible that in certain circumstances the virus might be carried to this country by the wind (paragraph 23).

(3) *By persons and motor vehicles arriving from the Continent*

Regular disinfection is not justifiable but circumstances might arise in which disinfection might be a wise precaution and the Ministry ought to have the power to impose it (paragraph 45).

(4) *By imported meat and animals*

(*a*) The measures to prohibit and control imports in this category that might be dangerous seem to be fully effective except as regards imported chilled and frozen meat from South America (paragraph 24). So long as we have to import meat from there, and as long as foot-and-mouth disease is endemic on that Continent, there must always be a risk that contaminated meat may cause outbreaks (paragraph 29).

(*b*) Swill that contains infected meat, or other waste contaminated by it, is a source of infection that is clearly of great importance (paragraph 26).

3. Collection of waste food (paragraph 40)

(1) All local authorities should be empowered (but none should be compelled) to dispose of waste food for feeding to animals.

(2) All waste food, whether collected by a local authority or privately, to be used for feeding to animals, should be sterilised by the collector.

(3) All substantial collectors of waste food other than local authorities should be required to take out a licence imposing on them an obligation to use an approved sterilising plant which would be periodically inspected.

(4) The question should be considered of assigning to local authorities the task of licensing collectors and inspecting their boilers or sterilising plant.

4. Disposal of refuse containing waste food (paragraph 42)

(1) If the statutory obligations of local authorities do not already include the duty of disposing of their refuse so as to involve no danger to animal health, the law should be amended.

(2) If that is already the duty of local authorities, the Government Departments concerned should make every effort to see that it is carried out.

5. International action against foot-and-mouth disease

International collaboration is essential for effective control (paragraph 88). The British Government should take any action in their power to resuscitate the interest of the other European Governments in the establishment of the European Commission for the Control of Foot-and-Mouth Disease (paragraph 90).

6. Vaccination against foot-and-mouth disease

(1) It may be accepted that in adult cattle monovalent and bivalent vaccines can give 90 per cent. protection (paragraph 100 (*a*)).

(2) It takes about 14 days for vaccination to produce full immunity (paragraph 100 (*b*)).

(3) It would not be safe to reckon on full immunity lasting for more than four months (paragraph 100 (*c*)).

(4) Young stock, particularly unweaned animals, are at least more difficult to vaccinate effectively than adult stock (paragraph 100 (*d*)).

(5) It seems probable that vaccines specific for sheep and pigs will be found necessary for the effective vaccination of these animals (paragraph 100 (*e*)).

(6) The possible danger of vaccines giving an animal the disease is not a serious argument against vaccination (paragraph 100 (*f*)).

(7) The possibility of masked infection by foot-and-mouth disease in animals vaccinated against it cannot safely be ignored (paragraph 100 (*g*)).

7. Vaccination in Great Britain as a substitute for stamping-out

In the circumstances of today, and of the immediate future so far as they are foreseeable, any idea that it would be possible to do away with stamping-out by making the whole susceptible animal population—or even all cattle—immune by vaccination is in the realm of fantasy (paragraphs 98 and 99).

In present circumstances stamping-out must continue to be the policy in Great Britain (paragraph 96).

8. Stamping-out and vaccination in combination in Great Britain

(1) *In normal times*

(*a*) *Ring vaccination.* The adoption of Ring vaccination in the circumstances of this country would not in normal times make any contribution to checking the disease that would justify the expense and diversion of effort it would entail (paragraph 110).

(*b*) *Frontier vaccination.* This would not be suitable in the circumstances of Great Britain (paragraph 111).

(*c*) *Compulsory vaccination of particular herds.* There could be no possible justification for compelling the owner of any particular herd in this country to vaccinate in normal times (paragraph 113).

(*d*) *Voluntary vaccination.* This should not be allowed pending the result of experiments into the reality of the danger of masked infection. The question should then be considered afresh (paragraph 119).

(*e*) The effect on our export trade in livestock will have to be taken seriously if ever the introduction of vaccination is thought to be desirable (paragraph 120).

(2) *During an epidemic*

(*a*) Preparations ought to be made for the use of vaccination in the event of the disease becoming so widespread that slaughter was no longer practicable or economic (paragraph 121).

(*b*) It would clearly be prudent to begin vaccination before an epidemic became so serious that slaughter had to be abandoned and to use the two methods in combination ; but at just what stage this should be started can only be decided at the time in the light of all the circumstances (paragraph 126).

9. Pirbright Research Institute

(1) The Institute deserve the reputation they have widely won as the most important centre in the world for research into foot-and-mouth disease (paragraph 125).

(2) The extension of the Institute that is now being carried out should prove most valuable, but it does not seem to be on a scale adequate for the supply of vaccine in the quantities that would be needed if

recourse to vaccination were necessary to combat an emergency (paragraphs 123 and 124).

(3) The present arrangements for the administration of the Institute should be clarified (paragraph 125).

10. Veterinary Research Council

The creation of such a body deserves careful consideration (paragraph 125).

11. The use of serum

It has all the drawbacks of vaccination and none of its advantages (paragraph 130).

12. Alleged cures and preventives

None of those brought to our notice have advantages over orthodox vaccination (paragraphs 131 to 135).

13. The 1951-52 epidemic in Great Britain

(1) The heavy invasion of eastern and southern England was resisted with no small success but a single outbreak in the Midlands that was not reported early enough was responsible for over half of the outbreaks that occurred during the epidemic (paragraphs 137 and 138).

(2) The disease was taken to Scotland by calves that were fed at Crewe station, while en route, with infected milk (paragraph 139).

(3) Unboiled swill, stored in the open, which contained scraps of meat salvaged from the carcases of apparently healthy contact animals was regarded as the origin of 83 outbreaks in Dumfries, Kirkcudbright and Cumberland (paragraph 140).

14. The Ministry's control arrangements

(1) *The size of the Infected Area*

The standard size should be reduced from a radius of 15 miles to one of 10 miles (paragraph 144).

(2) *Signposting of the Infected Area*

At least the main roads leading into the Infected Area should have warning signposts (paragraph 146).

(3) *Artificial Insemination in the Infected Area*

This should be permitted more freely. When the service has been suspended for three weeks, it should be the rule rather than the exception—even in prolonged outbreaks—for it to be resumed everywhere in the Infected Area except within two miles of the infected farm (paragraph 156).

(4) *Closing of footpaths and roads in the Infected Area*

The police should be empowered to close footpaths. When it is necessary to disinfect roads, both the police and the Ministry's veterinary officers should have power to close them (paragraphs 147 and 148).

(5) *Controlled Area restrictions*

They have never been imposed without reasonable justification. The Ministry's discretion in this connexion should not be fettered (paragraph 158).

(6) *Movement of susceptible animals into and within Infected and Controlled Areas*

The various Orders should be consolidated and simplified (paragraph 160).

(7) *Movement licences*

Counter-signature should be abolished (paragraph 161).

(8) *Inspectors under the Diseases of Animals Act*

(*a*) Local authorities should always appoint policemen as Inspectors (paragraph 162).

(*b*) The handbook of instructions should be brought up to date and the Ministry should supply all Inspectors with copies free of charge (paragraph 163).

(9) *Control of the disease in Scotland*

The present system of unified control throughout Great Britain should be maintained (paragraph 167).

(10) *The extent of slaughter*

An effective stamping-out policy must include the slaughter of contact animals. The question what contact is close enough to justify slaughter must continue to be decided in every case by the Ministry's veterinary officer (paragraph 180).

(11) *The place of slaughter*

Slaughter must continue to be carried out on the infected farm (paragraph 182).

(12) *The disposal of the carcases*

These should be burned instead of buried (paragraph 185).

(13) *Salvaging the carcases of apparently healthy contact animals for human consumption*

This practice should be stopped (paragraph 189).

(14) *Disinfection of infected premises*

Power-equipment should be used. The employment of trained squads should be considered (paragraph 177).

(15) *Disinfection at markets of animal-carrying road vehicles*

All market authorities should be obliged to provide proper facilities, including piped water, for cleansing and disinfecting vehicles (paragraph 178).

(16) *Feeding of milk to calves in transit*

This should be prohibited (paragraph 168).

(17) *Churn washings and waste milk*

These should not be taken away from dairies (or cheese factories) receiving milk from Infected Areas unless heat-treated sufficiently to destroy the virus (paragraph 169).

(18) *Sterilisation of milk churns*

This should be carried out by milk distributors before they send the churns back to the farms (paragraph 170).

(19) *Milk lorries*

(*a*) These should be prohibited from entering farms in Infected Areas. Farmers in those Areas should put their churns on loading platforms on the roads (paragraph 170).

(*b*) It would be a wise precaution if, in seriously affected areas, separate lorries were used for the conveyance of empty and full churns (paragraph 170).

(20) *Point-to-point races in Infected Areas*

These should be prohibited (paragraph 171).

(21) *Troops on manoeuvres*

These should not be allowed to go within two miles of infected premises (paragraph 172).

(22) *Slaughterhouse offal*

The practice of spreading this on agricultural land should be prohibited (paragraph 173).

(23) *Movement of animals by cattle dealers*

When the Tuberculosis Eradication Scheme has been completed, the Ministry should consider the imposition of a rule that cattle must be detained for six days at the next destination after every exposure for sale (paragraph 174).

(24) *Publicity about outbreaks of foot-and-mouth disease*

(*a*) Regional officers of the Central Office of Information should keep in close touch with the Ministry's local veterinary officers when outbreaks occur (paragraph 192).

(*b*) The Ministry should give the Press information about new outbreaks in Infected Areas (paragraph 193).

(*c*) Both the Press and the B.B.C. should be notified when Infected Area restrictions are withdrawn (paragraph 194).

(*d*) Both the Press and the B.B.C. should be given information about any exceptional building-up of infection on the other side of the North Sea or English Channel (paragraph 195).

(*e*) When restrictions are imposed, all farmers in the Infected Area should be notified individually by the police (paragraph 196).

(*f*) All veterinary surgeons practising in an Infected Area should be notified immediately of all outbreaks that occur in that Area (paragraph 197).

(25) *Education about foot-and-mouth disease*

(*a*) *Farmers.* The Ministry should give farmers full information about the symptoms of the disease and consider whether it is practicable to introduce some such scheme of continuous education on the subject as has been adopted in some European countries (paragraphs 198 and 199).

(*b*) *The general public.* More might be done to educate people in the neighbourhood of outbreaks about the danger of the disease (paragraph 200).

(*c*) *Veterinary Surgeons.* The Ministry should make every effort to overcome the handicap from which the veterinary surgeon in private practice at present suffers by lack of experience of the disease (paragraph 201).

(26) *Reporting of the disease*

In addition to reporting suspected foot-and-mouth disease, farmers in Infected Areas should report *any* illness in suspectible animals (other than hill sheep) (paragraph 202).

(27) *Penalties for delayed reporting*

(*a*) The power to withhold compensation should be abrogated (paragraph 204).

(*b*) The maximum fines should be increased to £500, or where the offence is committed with respect to more than ten animals, £50 for each animal (paragraph 205).

(*c*) The liability to imprisonment for a second offence should not be limited to a second offence committed within 12 months (paragraph 206).

(28) *Insurance policies*

The "waiting period" should be abolished (paragraph 207).

(29) *"Compensation" for slaughtered animals*

This is fair (paragraph 208).

(30) *Compensation for consequential losses*

This principle should not be accepted (paragraph 208).

(31) *Agricultural Shows (exhibition of cloven-hoofed animals)*

The Ministry's arrangements cannot reasonably be other than those now in operation (paragraph 210).

15. The Ministry's Veterinary Staff

(1) During the 1951-52 epidemic they carried out their duties with a zeal and efficiency deserving the highest praise (paragraph 211).

(2) Care should be taken to ensure that the conditions of service are such as will continue to attract men of a calibre adequate to the discharge of the exacting duties (paragraph 212).

We are greatly indebted to our Secretary, Mr. R. A. Thorne, M.B.E., of the Animal Health Division of the Ministry of Agriculture and Fisheries, both for the unfailing diligence and efficiency with which he has carried out his duties throughout our inquiry and for the invaluable help he has given us in the drafting of our Report. He has been ably and energetically aided by our Assistant Secretary, Mr. J. S. W. Henshaw, and to him also our warm thanks are due.

ERNEST GOWERS (Chairman)
E. D. ADRIAN
HENRY J. CATOR
WYN GRIFFITH
HUNGARTON
ALEX. ROBERTSON
A. R. SEMPLE
HAROLD WOOLLEY

R. A. THORNE (Secretary)
J. S. W. HENSHAW (Assistant Secretary)
13 July, 1954.

EVIDENCE RECEIVED

The following bodies or individuals have expressed views to us orally or in writing. Those who gave written evidence only are marked with an asterisk.

(1) GREAT BRITAIN

(*a*) Government Departments and Local and Public Authorities

*Aberdeen and District Milk Marketing Board

Agricultural Research Council—

Represented by Sir William Slater

*Berkshire Agricultural Executive Committee

*Board of Inland Revenue

British Broadcasting Corporation—

Represented by Mr. A. E. Barker

*British Transport Commission

Central Office of Information—

Represented by Mr. D. Cranston

Department of Agriculture for Scotland—

Represented by Sir Patrick Laird
Mr. L. G. Davidson
Mr. R. G. C. Nisbet
Mr. A. J. Bean

Dumfries and Galloway Constabulary—

Represented by Mr. S. A. Berry

Foot-and-Mouth Disease Research Institute, Pirbright—

Represented by Professor Wilson Smith
Professor R. E. Glover
Dr. C. H. Andrewes
Dr. I. A. Galloway
Dr. W. M. Henderson
Dr. J. B. Brooksby
Mr. H. H. Skinner
Mr. J. R. Haddow
Dr. C. J. Bradish

*Home Office

Kent Agricultural Executive Committee—

Represented by Mr. E. Brundrett
Mr. A. B. Long

Lambeth Borough Council—

Represented by Mr. F. Batterbury, Borough Engineer

Luton Borough Council—

Represented by Mr. John Stephen, Director of Public Cleansing

Milk Marketing Board (of England and Wales)—

Represented by Mr. T. Peacock
Mr. W. R. Trehane
Sir Frank Ware
Mr. G. F. Smith
Dr. J. Edwards

Ministry of Agriculture and Fisheries—

Represented by Mr. W. C. Tame
Mr. J. N. Ritchie
Mr. A. D. J. Brennan
Mr. D. S. Barbour
Capt. V. Boyle
Mr. A. B. Kerr
Mr. W. Watt
Mr. E. R. Callender
Mr. E. R. Corrigall
Mr. P. D. Baylis
Mr. B. A. Claxton
Mr. W. W. Wilson
Mr. R. C. Matheson
Mr. H. G. Lambert
Mr. A. E. Gregory
Mr. A. D. Bird

*Ministry of Agriculture for Northern Ireland—

Ministry of Food—

Represented by Mr. W. H. Wilkin
Mr. S. J. Brickstock
Mr. A. Fillmore
Mr. W. J. B. Hopkinson

North of Scotland Milk Marketing Board—

Represented by Mr. P. M. R. Pottie
Brigadier J. E. Stirling
Mr. R. A. Russell

Reading Cattle Breeding Centre of the Ministry of Agriculture and Fisheries—

Represented by Mr. D. L. Stewart
Mr. James Mackintosh
Mr. D. S. Strang

(*b*) Voluntary Associations

*Aberdeen-Angus Cattle Society

Association of Chief Police Officers—

Represented by Mr. D. Osmond
Mr. N. W. Fowler

Association of County Councils in Scotland—

Represented by Rev. J. A. Fisher
Mr. J. S. Dickson
Major D. C. Bowser
Mr. J. C. Grant
Mr. A. L. Bushnell
Mr. D. A. Aitken
Dr. G. Matthew Fyfe

*Association of Municipal Corporations

Association of State Veterinary Officers—

Represented by Mr. A. M. Graham
Mr. G. Tullis
Mr. A. G. Beynon

*Association of Veterinary Teachers and Research Workers

Blackface Sheep Breeders' Association—

Represented by Mr. J. A. Cameron
Mr. W. Ross-Taylor

*British Friesian Cattle Society

*British Kerry Cattle Society

British Veterinary Association—

Represented by Mr. A. M. Graham
Dr. R. F. Montgomerie
Mr. A. J. Wright
Mr. H. F. Hebeler
Mr. G. Tullis

Chartered Auctioneers' and Estate Agents' Institute—

Represented by Mr. E. C. Ingram
Mr. C. E. J. Gaze
Mr. Stuart Wyatt
Mr. J. Muir Watt

*Cheviot Sheep Society

*Clun Forest Sheep Breeders' Society

Counties of Cities Association—

Represented by Mr. J. Norval
Mr. S. G. Abbott

County Councils' Association—

Represented by Mr. W. J. Cumber
Sir Edward Hardy
Mr. H. O. Brown
Mr. G. P. Attenborough

*Devon Cattle Breeders' Society

*Devon Longwool Sheep Breeders' Society

*Dorset Down Sheep Breeders' Association

*Dorset Horn Sheep Breeders' Association

*English Guernsey Cattle Society

Gloucester Cattle Society—

Represented by The Hon. R. H. Bathurst

*Hampshire Down Sheep Breeders' Association

*Herdwick Sheep Breeders' Association

*Institute of Auctioneers and Appraisers in Scotland

*Kent or Romney Marsh Sheep Breeders' Association

*Leicester Sheep Breeders' Association

Livestock Export Group—

Represented by Mr. A. E. Baldwin, M.P.
Col. D. Kennedy
Mr. F. Neville Matthews
Mr. J. C. Langer

National Cattle Breeders' Association—

Represented by The Hon. Mrs. Butler Henderson
Mr. W. H. Bursby
Mr. W. S. Biggar

National Farmers' Union of England and Wales—

Represented by Mr. R. J. Charlton
Mr. J. W. Salter Chalker
Mr. W. L. Keene

National Farmers' Union of Scotland—

Represented by Mr. G. Hedley
Mr. A. H. B. Grant
Mr. W. Young

National Pig Breeders' Association—

Represented by Mr. R. H. Jenkinson
Mr. S. D. Player

*National Sheep Breeders' Association

National Union of Agricultural Workers—

Represented by Ald. W. A. J. Case
Mr. A. Holness
Mr. W. H. Pearson
Mr. J. Stewart

*Red Poll Cattle Society

Royal Agricultural Society of England—

Represented by Sir Merrik R. Burrell, Bt.
Mr. J. E. Bennion
Sir Peter McClintock Greenwell, Bt.

Royal College of Veterinary Surgeons—

Represented by Professor J. G. Wright
Professor W. I. B. Beveridge
Professor R. E. Glover
Mr. G. N. Gould

Road Haulage Association, Limited—

Represented by Mr. E. W. Watts
Mr. S. Peers

Royal Highland and Agricultural Society of Scotland—

Represented by Capt. James Craig
Mr. R. H. Watherston
Mr. J. Wither
Mr. Alexander Anderson

Royal Welsh Agricultural Society—

Represented by Mr. T. H. Jones

Scottish Pig Producers' Association—

Represented by Mr. G. Honeyman Tennent
Mr. Wm. Laird

*Shorthorn Society of the United Kingdom of Great Britain and Ireland

*Shropshire Sheep Breeders' Association and Flock Book Society

*Society of Border Leicester Sheep Breeders

*South Devon Herd Book Society

*Southdown Sheep Society

Transport and General Workers' Union—

Represented by Mr. T. J. Healy
Mr. T. Parsons
Mr. S. L. Aldous

Food and Agriculture Organisation of the United Nations—

Represented by Sir Thomas Dalling, Chief Veterinary Consultant

*World Federation for the Protection of Animals

(*c*) Private Individuals

Mrs. A. M. Allen
*Mr. James Bain
*Col. G. G. M. Batchelor
Major C. W. S. Blackett
*Major F. Chandler
Dr. W. M. Crofton
Lord Dorchester
Mr. P. Fryer
Mrs. J. Halcrow
*Col. Heywood-Lonsdale
The Earl of Iveagh
Mr. J. G. Jenkins
Mr. Charles Jewell
*Mr. G. C. Lancaster
Mr. L. Langmead
*Mr. J. E. R. McDonagh
Mr. G. Macdonald Crawford
The Earl of Malmesbury
Col. R. Meinertzhagen
*Mr. E. Morgan
Mr. Alexander Murray
Mr. F. Newman Turner
Major W. H. Osman
Mr. W. Pickford
*Lady Seton
Mr. W. N. Shearing
Mr. J. K. Smith

(2) Evidence from other Countries

(*a*) Countries whose Governments submitted written evidence

Argentina
Australia
Austria
Bechuanaland
Belgium
Canada
Ceylon
Cyprus
Denmark
Eire
Finland
France
German Federal Republic
Gold Coast
Greece
Holland
India
Italy
Kenya
Malaya
New Zealand
Nigeria
Northern Rhodesia
Norway
Nyasaland
Pakistan
South Africa
Southern Rhodesia
Spain
Sweden
Switzerland
Tanganyika
Turkey
Uganda
Uruguay
U.S.A.
U.S.S.R.

(*b*) Foreign countries visited by the Committee: and persons who gave evidence in them

France: M. Dufour
M. Girard
M. Merle
M. Quentin
M. Salomon

Switzerland: Dr. Degen
Professor Fluckiger
Dr. Moosbrugger

Belgium: M. J. Bouckaert
M. Duhaut
M. Heger
M. P. Holvoet
Dr. Willems

Holland: Dr. J. M. van den Born
Dr. Frederiks
Dr. de Haan
Dr. Hendrikse
Mr. Wagenvoort

Denmark: Dr. Fogedby
Dr. Michelsen
Dr. Wøldike Nielsen
Dr. Siedel
Dr. Spydsgaard

Argentina: The Director, Liniers Cattle Market
Dr. Escobal
Mr. Laird
Mr. O'Grady
Dr. Palma
Dr. Rossi
Dr. Schang

[While in Argentina the Committee visited ranches owned by Senor Harriett, the Australian Land, Mercantile and Finance Company and Bovril, Limited.]

Norway: Dr. Baggerud
Professor Flatla
Dr. Gjestdal
Professor Hauge
Dr. Slagsvold
Mr. Ullestad

Sweden: Dr. Alegren
Dr. Borg
Dr. Bouveng
Dr. Liljeblad
Dr. Palsson

[While in Sweden the Committee attended the session about foot-and-mouth disease at the 15th International Veterinary Congress.]

(*c*) While abroad the Committee also took oral evidence from:

Professor G. Ramon, Director of the International Office of Epizootics

Dr. Simms, Chief of the Animal Disease and Parasite Research Branch, Agricultural Research Service, United States Department of Agriculture

Dr. Eichorn, Dr. Ellis, Dr. Cunha, Dr. Ordonez and Mr. Mata of the Pan-American Foot-and-Mouth Disease Centre, Rio de Janeiro

Professor Beyers of the World Federation for the Protection of Animals

Dr. Ohly of the German Federal Republic Veterinary Service

THE NATURE OF FOOT-AND-MOUTH DISEASE

(By Dr. W. M. Henderson, Research Institute, Pirbright)

The history of the disease

1. Foot-and-mouth disease is first recorded as having appeared in England in August, 1839. At that time the importation of susceptible animals was prohibited, but as the disease existed in France and the Netherlands it was probably brought here from the Continent by indirect means. The disease spread to various counties in England and then to Scotland and Ireland. Thereafter it continued in this country, although there were periods when it was dormant. The most serious outbreaks occurred in 1871 when the number of animals affected was estimated at 3,000,000. It was this epidemic that led to the disease being made notifiable under the Contagious Diseases (Animals) Act, of 1869. Continued outbreaks led to the adoption of the stamping-out policy in 1892, and there were no outbreaks in the years 1895-99, 1903-07 and 1917. With these exceptions some outbreaks occurred every year. There were serious epidemics in 1922 (over 1,000 outbreaks), 1923 (nearly 2,000 outbreaks) and in 1924 (nearly 1,500 outbreaks) but by 1928 the incidence of the disease had decreased considerably. [The number of outbreaks in the succeeding years is shown in the Table facing page 10 of the Report and in the graph in Appendix III.]

The disease and its symptoms

2. Foot-and-mouth disease is so named because the most constant and obvious change produced by the infection is the development of large painful vesicles (blisters) in the mouth and on the feet of the sick animal. The disease is caused by a minute virus which is capable of multiplying or reproducing itself many millions of times in certain tissues of susceptible animals, particularly in the tissues covering the tongue, the lips, the roof of the mouth and the cleft of the cloven hoof. The vesicles develop as a result of the multiplication of the virus at these sites. Other places also are affected in some animals; for example the mouth pad of those that have no upper front teeth (the ruminants: cattle, sheep, goats, deer, etc.), the teats and udder of cows, the snout of pigs and the junction between the horn and the skin right round the foot in pigs, the smaller ruminants and, much less frequently, in cattle. The virus multiplies inside the body also, and similar vesicles are found on the lining of the stomachs of cattle. At the time the vesicles are developing, the virus particles escape into the blood stream and are thus carried to all parts of the body, with the result that all tissues of the animal and all discharges from it contain virus.

3. The incubation period of the disease is usually about 3 to 8 days. It may be as short as 24 hours. Or it may be as long as 2 to 3 weeks, especially if the amount of virus causing the infection is small. If cattle are infected experimentally by direct inoculation of the highly susceptible tissue of the tongue, the virus soon starts multiplying, and vesicles become visible 12 to 24 hours later. The affected animal is recognised by the effects of the pain of the vesicles and the high fever present during the illness. There is excessive salivation, smacking of the lips, difficulty in chewing, acute lameness and marked loss of condition. It is common for in-calf cows to abort; those in milk usually go dry and the previous yield may not be regained in subsequent lactations. For the first few days the sick cow looks miserable and dejected; copious flecks or even ropes of foamy saliva drool from its mouth; its head is down; its coat is staring and unlicked; its flank is sunken; its feet are grouped together under its body and it can only be made to move with difficulty. When the vesicles on the feet are fully developed, and when later they burst, the pain may be so severe that the animal remains lying down. Very young animals may die without showing the characteristic signs of the disease. In adult stock all but 2 to 3 per cent. recover except when the strain of virus responsible for the outbreak is unusually virulent. Recovery, if uncomplicated, is comparatively rapid in spite of the severity of this acute illness. The mouth and tongue heal quickly; the difficulty in eating disappears; and after two

to three weeks the animal begins to regain some of its lost condition. But progress is often checked: in some cases the raw surfaces exposed by the burst vesicles and the poor condition of the sick animal allow other infections to become established, sometimes with fatal results. This applies particularly to the feet, and prolonged lameness may result; shedding of the horn is common in pigs. In dairy cows secondary infection of the udder may cause permanent damage. At this time also other infections already carried by the animal may flare up with fatal results.

4. Cattle and pigs are the most important of the susceptible species and it is not unusual to find the disease in sheep; goats are less commonly affected. All the wild ruminants such as deer, antelope and buffalo are susceptible. In addition to these cloven-footed animals, hedgehogs and rats are known to have been naturally infected. It has also been reported that human beings have occasionally been attacked.

Diagnosis

5. In Great Britain there is never any difficulty in diagnosing the typical outbreak of foot-and-mouth disease, but atypical cases sometimes occur when only one animal may be affected with a few, poorly developed vesicles. It is possible, however, by means of laboratory tests, to discover rapidly whether this suspicious-looking condition is infection with the virus of foot-and-mouth disease. Portions of tissue from the vesicles are collected and examined for evidence of the presence of virus either by a test-tube test, called the complement-fixation test, or by inoculating susceptible animals with the suspected material. In certain countries, in North and South America for example, the diagnosis of foot-and-mouth disease is complicated by the existence of a second virus disease, vesicular stomatitis, which produces many of the same changes in cattle and occasionally in pigs. Horses also are susceptible to this disease, but in them diagnosis is not the same problem because they are not susceptible to foot-and-mouth disease. These two diseases can be rapidly distinguished by laboratory tests, the most important of which is the complement-fixation test. In the United States of America another virus disease is found in pigs—vesicular exanthema—also similar in appearance to foot-and-mouth disease. Here again examination of material from the affected animals is necessary before a diagnosis can be made.

Virus strains and types

6. The virus of foot-and-mouth disease has many diverse characters, and great differences are found between strains of virus isolated from different outbreaks of the disease. There are differences in the ease with which the virus can infect different species of animals, in the ease with which the virus can spread the disease from animal to animal, in the severity with which the virus infects, in the length of time that the virus can survive under different conditions and in the degree of immunity that the disease leaves behind it. Infection with any virus leaves the recovered animal protected for a time against reinfection with that same strain, but a strain possessing different characteristics may be able to infect it at once. Research into this characteristic of the virus of foot-and-mouth disease has shown that the strains can be sorted into different groups or "types". This grouping is based on the results of tests of immunity, and the types are therefore referred to as "immunological types". Three quite different types have been known to occur for many years; they are called O, A and C. Strains of these types have been isolated from outbreaks of the disease in most countries of the world. Recently the existence in Africa of three new and quite distinct types has been discovered. From their association with outbreaks in different territories of southern Africa they have been named S.A.T. 1, 2 and 3. As well as these separate immunological types, similar differences of lesser degree have been found to exist in strains of the same type. These different strains of the same type are called variants; for example A type are called variants A_1, A_2, A_3, etc. A recent survey of the literature on this subject shows that different workers have labelled at least 3 variants of type O, 11 of type A and 3 of type C. There is not as yet enough informa-

tion to say whether all these variant strains have sufficiently different characters to warrant their being treated as distinct identities. Variant strains have also been found to occur within the African types. The small differences in the immunity produced by the different variants of a single type have only been discovered with the aid of new and more sensitive methods of examining this characteristic of the strains. Knowledge of such differences is of great importance in connection with vaccination.

7. In the preparation of foot-and-mouth disease vaccine, the virus is so treated that it can no longer infect an animal but can still stimulate the production of immunity. This immunity is not usually as strong as that following recovery from actual infection. Thus vaccine prepared from one type-variant strain may give only partial protection against other variants of the same type, even when actual infection with that variant would result in immunity to the others.

8. Immunity to foot-and-mouth disease does not last very long, even without the complication of the possibility of immediate reinfection with a strain of another type. Following infection it lasts for one or two years, but following vaccination it does not last for longer than about six months. During this time, in both cases, the degree of protection against the disease gradually decreases, so that, although an animal recently recovered might completely resist infection with a variant strain of the same type, it would be less well protected as its immunity waned.

9. A complete and final classification of the variant strains within any one type is not yet possible. It may indeed never be possible unless there proves to be a limit to the degree of variation that may occur. The occurrence of variant strains has been observed in two sets of circumstances during waves or epidemics of the disease. Occasionally a number of variant strains may be isolated during a single epidemic. This happened in the series of outbreaks that started in Mexico in 1946. What is more usual in an epidemic on the continent of Europe is that the great majority of the outbreaks are caused by the spread of one distinct strain, and that the next wave of the disease, perhaps a year or two later will be caused by another type or by another variant of the same type.

The resistance of the virus

10. The virus of foot-and-mouth disease is a parasite that cannot multiply except in the living tissue of a susceptible animal, but it can survive in dead tissue or away from the body of its host for very long periods. It is rapidly destroyed by direct sunlight, by high temperatures and by some disinfectants. Drying, darkness and cold favour its survival, but the length of time that it remains infective depends on a number of factors. Tests in the laboratory have shown that, if liquid containing virus, as for example blood or the fluid from the vesicles, is allowed to dry on different materials kept indoors at room temperature, it may remain capable of infecting animals after 14 days on wool, 4 weeks on cow's hair, 11 weeks on boot leather, 14 weeks on rubber boots, 15 weeks on hay and 20 weeks on bran. The conditions of cold-storage used in the meat trade are ideal for maintaining the infectivity of the virus. When an animal is slaughtered all the musculature "sets" or goes into *rigor mortis*. This change is accompanied by the production of acid which kills the virus in the muscle of an infected carcase in one to two days. But other parts of the body such as liver, kidney, tripe, bone marrow and lymph nodes do not become so acid. In these tissues the virus has been found to survive for 4 to 5 months at the cold-storage temperatures ordinarily used in the meat trade. In the laboratory many strains of the virus are kept for future work. If pieces of the skin of vesicles from the tongues of infected cattle are kept in the most favourable conditions for survival of the virus, they will remain infective for many years.

Spread of the disease

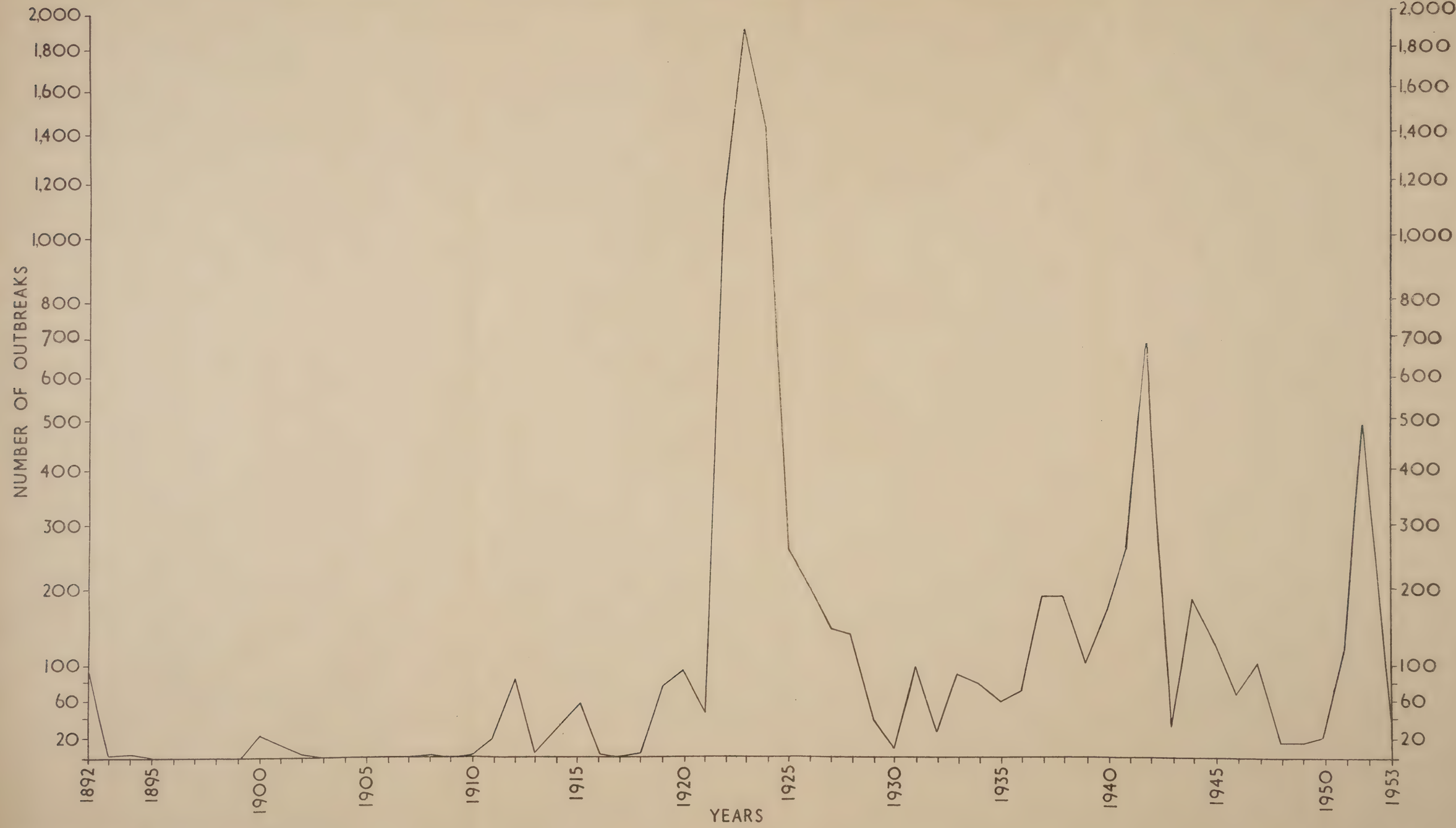
11. All the tissues and all the discharges of an animal suffering from foot-and-mouth disease are infective; none more so than the fluid of the vesicles, which contain hundreds of millions of individual virus particles. The disease is spread

by a few virus particles from a sick animal reaching a healthy animal either by direct or by indirect means. When the vesicles on the tongue burst, it is obvious that the saliva will become very infective. At this time the urine, dung and milk will also contain virus, and it is very easy for everybody and everything in the vicinity of the sick animal to become contaminated. The most important way in which the disease spreads is direct from animal to animal, and with the close contact normally found in byres, yards, markets, lairages and transport vehicles it is unusual for any susceptible cattle or pigs exposed to infection in such a way to fail to develop the disease. When an affected animal is at pasture, flecks of saliva may be blown by the wind for a considerable distance and thus reach other animals.

12. Indirect transmission of the disease is also of great importance. From what has been said previously about the long periods for which the virus has been proved to survive, it will be apparent that the strictest precautions have to be taken to prevent the infection being spread indirectly on the person and clothing of milkers and stock keepers, on farm produce whether used as food for animals or as packing material, and in all products of animal origin such as beef or pork carcases, hides, or glands for manufacture of drugs. So great are the powers of survival of the virus that it may be passed mechanically a number of times before it finally reaches and infects a susceptible animal. The roads, loading docks, etc. along which affected animals have passed and the wagons in which they have travelled may remain infective for some time. Other animals and birds on the farm, not themselves susceptible, may act as mechanical carriers of the disease. Hedgehogs and rats, as previously mentioned, may become infected, and they could therefore transmit the disease direct.

13. The very large amount of virus produced by the affected animal, the long periods for which the virus may survive, the ease with which a susceptible animal may be infected and the short incubation period of the disease—all these unite to make foot-and-mouth disease one of the most infective and most rapidly spreading diseases known.

Outbreaks of Foot-and-Mouth Disease in Great Britain 1892–1953



Vertical scale divided logarithmically

To face page 94

FOOT-AND-MOUTH DISEASE

Numbers of outbreaks in Great Britain, France, Germany, Belgium and Holland 1929–1953

30095

To face page 94

AN ACCOUNT OF THE OUTBREAKS OF FOOT-AND-MOUTH DISEASE IN GREAT BRITAIN NOVEMBER, 1951—NOVEMBER, 1952

(Based on the evidence given by the Ministry.)

1. In the late summer and autumn of 1951 a heavy weight of infection began to build up in south-eastern Europe and Western Germany. Most continental countries are never entirely free from foot-and-mouth disease, and vaccination is extensively practised; but the virus responsible for this epidemic was found to be a highly virulent variant of type A, against which the vaccines prepared as protection against other more prevalent types of the virus afforded little or no immunity. The disease spread rapidly, and by early November Denmark, the Netherlands, and Belgium each had many thousands of outbreaks. Experience has shown that when there is much disease in the costal regions of the Low Countries at the time of the autumn migration of birds, primary outbreaks are likely to occur among the livestock in eastern and south-eastern England. These began on the 14th November.

2. From that date until the 4th November, 1952, when the British epidemic ended, there were 583 outbreaks in this country. These fell into three main groups, namely:—

(1) *Eastern England*—winter and early spring (14th November, 1951—19th April, 1952)—during which period there were 87 primary and 65 secondary outbreaks.

(2) *Southern England*—spring, summer and autumn, 1952 (21st April—4th November)—during which period there were 40 primaries and 95 secondaries.

(3) *Cheshire, the Midlands, Wales and Scotland*—spring and summer, 1952 (6th April—13th August)—where there were 6 primaries and 290 secondaries.

(1) *Eastern England*—winter and early spring outbreaks

3. On the 14th November, two widely separated outbreaks occurred on the East Coast, one in Yorkshire and the other in Essex. The virus was type A, the same type as in the continental outbreaks, making its first appearance in this country since 1944. These were followed within a week by no fewer than 20 primary outbreaks along the East Coast from Yorkshire to Essex—evidently a sudden, heavy invasion from the Continent.

Yorkshire

4. Between November and February there were 11 primary outbreaks in the East Riding, and these gave rise to 14 secondaries. The North and the West Ridings escaped lightly with only one outbreak each. At Thearne, in the East Riding, there were two outbreaks on the same premises. The first was at the beginning of December and the second about 10 weeks later, after restocking had taken place. The second was thought to be a survival from the first, and was attributed to infection being retained in contaminated baled hay. In an outbreak at Aldbrough, stock which had been given kale in their ration became infected, but animals that had not been remained healthy. It was therefore assumed that the kale had become contaminated by some means not discovered—possibly by birds. A secondary outbreak at Hull was thought to have been caused by infection having been conveyed there by a veterinary surgeon who had previously visited the infected premises at Aldbrough.

Lincolnshire

5. An isolated outbreak was confirmed about the middle of November in cattle grazing on the marshes at Goxhill on the Lincolnshire side of the River Humber. Later in the month there was another outbreak in the Lincolnshire coastal area, at Theddlethorpe. The disease broke out in housed cattle that were fed with cabbages from a field where starlings were reported in very

large numbers. Infection carried by human agency gave rise to a secondary outbreak at Louth. At the end of December the disease again appeared in the district, this time at Saltfleetby, and spread to adjoining premises. Altogether there were five outbreaks in this county, three of which were primaries.

Nottinghamshire

6. In this county there was only one outbreak; a primary that occurred at Thurgarton about the middle of November.

Leicestershire

7. The first outbreak, an isolated primary, was confirmed at Tilton-on-the-Hill in November. It was not until January that another occurred—a primary at Frisby-on-the-Wreak. The stock on the home premises were slaughtered. It was decided not to slaughter the sheep, which were in a distant field; they were found to be healthy and there was no evidence of contact, direct or indirect. Nevertheless they contracted the disease three weeks later and were slaughtered. At the beginning of February there was an outbreak among cattle at Burton Lazars. These three outbreaks resulted in five secondaries.

Norfolk

8. There were 34 outbreaks between the middle of November and early January, fifteen of which were classed as primaries. Three secondary outbreaks in the Norwich area were thought to have resulted from visits by a veterinary surgeon who had unsuspectingly examined affected animals on two other farms. On one of these farms stock had been affected for over a week before disease was reported. Another secondary was attributed to a visit made by an employee to an infected farm. A secondary outbreak at Acle was regarded as the outcome of a sale by a dealer on whose premises disease was subsequently confirmed. An outbreak of special interest in Norfolk was at Fritton early in January. The disease was diagnosed in a cow which had been artificially inseminated the previous day while in the incubative stage of the disease. The inseminator had made eleven other visits the same day. All cows handled by him on these farms were slaughtered and there were no outbreaks on them.

Suffolk

9. Of the 52 outbreaks in Suffolk, 30 were classed as primaries. As in most of the other eastern counties, the first outbreak occurred about the middle of November. The main centre of the disease was on a stretch of country inland from Lowestoft to Beccles. Around Beccles there were 14 cases; they included an outbreak at the Milk Marketing Board's Cattle Breeding Centre, where the stock of 33 bulls was slaughtered. In January the disease was confirmed in the Ministry of Food's slaughterhouse at Leiston. The infected animal had come through a Collecting Centre from premises at Framlingham where disease was afterwards found. After a comparative lull there was a single outbreak in February on premises near Harleston, where there had been disease in the previous November and fresh stock had been introduced about the middle of January. This was regarded as a recrudescence; the persistence of infection was believed to have been due to a piece of rope used during the slaughter of stock at the first outbreak. This had been put on one side, was missed at disinfection, and was used to tie up a broken post in the yard accommodating the new stock. In March there was an outbreak at Southwold, and in the next four weeks 16 others; one again at Beccles, and others at Felixstowe and Stowmarket, where there was local spread giving rise to 8 cases at Haughley. A recurrence of disease was recorded at Framlingham, where an outbreak had occurred in January. It is not known whether this was a fresh introduction of infection or the virus had survived from the earlier outbreak on this farm. The last outbreak in the series, a primary, occurred at Elveden in April and necessitated the slaughter of a valuable herd of Guernseys.

Essex

10. The first outbreak in Essex (and one of the first two in the county) occurred at St. Osyth on the 14th November. Spread from it caused two others. Another primary occurred at Writtle, near Chelmsford, about the same time.

There were no further outbreaks until the middle of March, when the disease was discovered in a cow wintering out on marshes on Foulness Island. Pedigree sheep were the victims of an outbreak at Mistley in April. Altogether there were five primaries and three secondaries in the county.

Kent, Surrey, Sussex and Hampshire

11. During the period in question there were nine primary outbreaks in these counties but only one secondary. Seven of the primaries were attributed to birds. In all those cases a large number of starlings were seen feeding in the cattle yards or in the immediate vicinity a few days before the outbreaks were confirmed. An outbreak in cattle on a farm at Maidstone was attributed either to starlings or to drainage from an adjacent sausage factory using imported meat.

(2) *Southern England*—spring, summer and autumn outbreaks

12. By April, the disease had spread further west on the Continent and a very large number of outbreaks occurred in Northern France. Towards the end of that month the second phase of the epidemic began with outbreaks in our southern counties. These reached their peak in May and June. The situation had considerably improved by the end of June but a few sporadic outbreaks occurred in July, August and September. It will be seen from the following table that three-quarters of the outbreaks in this phase occurred in the Kent-Sussex area.

	Total number of outbreaks	*Primary outbreaks*
Kent	38	14
Sussex, East	37	12
Sussex, West	10	6
Hampshire	6	1
Isle of Wight	5	1
Wiltshire	2	1
Dorsetshire	4	2
Devonshire	3	1
Berkshire	13	2

Kent

13. The earliest of the spring series of outbreaks were at Sittingbourne, Dover and Folkestone in May. They were classed as primaries and attributed to bird-borne infection. Another primary occurred about the same time at Tonbridge, but its origin was obscure. The disease was carried from there, by a breeding movement, to a farm 5 miles away at Yalding. The Ashford district was badly affected; between May and August there were 26 outbreaks in that locality. Incidence was heavy among the many sheep there. In some cases the disease was not suspected in its initial stage, and in one outbreak at Kennington it may have been as much as 8 weeks old when it was diagnosed. This outbreak was probably responsible for many of the secondary outbreaks in the district. Away from the main centre of infection there was an outbreak at Appledore in June. In August there were two near Canterbury, both of which were regarded as primaries. Two other primary cases occurred in September, one in the Ruckinge area and the other, the last of the series, at Dymchurch.

East and West Sussex

14. The 1952 spring invasion of these counties started with outbreaks at the end of April near Rye Harbour and at Horsham. At Rye the animal infected was grazing in a field known to be a landing place for migratory birds from the south. Later the disease appeared in cattle grazing on the marshes near Pevensey. Seven further outbreaks occurred within a radius of two miles from Halland between the middle of May and the middle of June; the first two happened concurrently and were regarded as primaries. At Heathfield, some ten miles further east, there was an outbreak towards the end of May and this resulted in three secondaries within a mile. The worst spread occurred at Hailsham with twelve secondary outbreaks, all within a mile. One secondary was discovered

at a slaughterhouse where disease was found in a carcase that had come from the premises at Hailsham on the day that the outbreak there was confirmed. Towards the end of May cattle at Fernhurst, West Sussex were affected by the disease and this caused a secondary outbreak on contiguous premises. There were further outbreaks in the Rye district towards the end of June; and the other coastal districts affected were Battle, Guestling (near Hastings), Eastbourne, Shoreham-by-Sea and Bognor. An outbreak at Upper Beeding, West Sussex in August, the origin of which was not traced, resulted in six other outbreaks in the locality. Horsham became infected again in September. A few days before the outbreak occurred a large flock of starlings appeared. A further case at Horsham a fortnight later was attributed to local spread.

Hampshire

15. Ringwood had an outbreak in April, and the infection spread to six adjoining farms. The farms are in marsh land in the Avon valley, which abounds in wild life; and this may be the explanation of the spread. It was not until October that another outbreak occurred in the county. This was near Andover and resulted in two secondaries.

Isle of Wight

16. There were five outbreaks in the Island. There was evidence that four of them resulted from local spread of infection from the parent outbreak at Carisbrooke in May, where the disease was thought to have been introduced by birds.

Wiltshire

17. An outbreak in cattle at Crudwell in May resulted in one secondary, on adjoining premises. The origin of the first outbreak was obscure but was probably bird-borne infection; an unusually large number of birds were reported to have visited the farm a week or so before the appearance of disease.

Dorsetshire

18. In addition to an outbreak at Alderholt in June, which was connected with the outbreaks at Ringwood in Hampshire, there were three outbreaks at Wareham. The first of these was a primary, and attributed to bird-borne infection. The disease spread to an adjoining farm. After an interval of 17 days a further outbreak occurred two miles away.

Devonshire

19. An outbreak at Plymtree about the middle of June, the origin of which was not established, resulted in two adjoining farms being infected.

Berkshire

20. There was an outbreak towards the end of April near Faringdon. No certain origin was found for this case, but birds were thought to be the probable vectors. Six secondary outbreaks occurred in the neighbourhood; in one of these, infection was believed to have been carried by a milk lorry. In June there were two outbreaks at Compton. One of the farms was heavily infected; it was estimated that the disease had existed there for more than a week before being reported. Local spread from this farm resulted in six other outbreaks in the immediate vicinity.

(3) *Cheshire, the Midlands, Wales, Cumberland and Scotland.*

21. For reasons which will appear later, the arrangements for controlling the spread of the disease were far less effective in this group than in the other two. At least 290 out of the 296* outbreaks seem to have been caused by spread from a single unexplained outbreak that occurred at Checkley, near Crewe, on the 6th April.

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* Five of these were classified as primaries because no connexion with other outbreaks could be traced. Nevertheless it is thought that they probably arose indirectly from the outbreak at Checkley.

Cheshire and the Midlands

22. The exhaustive enquiries that were made into the Checkley outbreak failed to reveal any connexion with any other outbreak in Great Britain. As it was remote from the bird migration zones, it seems unlikely that infection could have been brought to the district by birds from France; but large numbers of swallows and house martins were reported to have arrived at the farm buildings a few days before some of the cattle began to ail. The sick animals were seen by a veterinary surgeon on two successive days and it was not until a further visit on the third day that he suspected foot-and-mouth disease and it was reported. By that time the disease had spread to over 50 cattle on the farm, and within the next eight days it had also spread to 22 other farms within a radius of five miles. So began a chain of events that was to prove disastrous.

23. A cow from one of the infected farms had been sent, before the disease was discovered, to another farm at Eccleshall, Staffordshire. The disease broke out there. Milk from this farm had been sent, via Fole Dairy, to Fole Milk Factory. Stock on three farms that had milk churn washings from the Fole Milk Factory contracted the disease. Fifteen other outbreaks occurred in this locality, some of which were probably caused by infected milk churns handled in the course of normal traffic to and from the Fole Dairy.

24. About the same time the disease broke out at Congleton (12 miles from Checkley) but no connexion with outbreaks at Checkley could be traced. In the Congleton outbreak the disease was 48 hours old when discovered, and the affected animals had been treated by a veterinary surgeon. There was no local spread around Congleton but milk from this farm went via a Congleton dairy to premises at Bramhall, Stockport, where an outbreak was confirmed on the 28th April. The history of this outbreak is instructive. Two calves fed on milk from Congleton died on the 18th April. They were examined *post mortem* by a veterinary surgeon but the cause of death was not discovered. On the 20th April a bull on the premises became ill. On the 21st and 22nd April the bull was examined by other veterinary surgeons, and they also saw an ailing cow, but they did not diagnose foot-and-mouth disease. Other cows became ill and a further examination was made by a veterinary surgeon on the 25th April, again without accurate diagnosis. It was not until a still later visit on the 28th April that suspected foot-and-mouth disease was reported. Cows sold during this period caused outbreaks at Marple and at Rowarth in Derbyshire.

25. Cattle were moved from Chapel-en-le-frith to Kettering Market in the cattle transport lorry that had taken cows from Bramhall to Marple. These developed the disease and subsequently infected certain markets in the Midlands. (Details are given in paragraph 27.) On the 20th April disease was confirmed at Stoke, near Nantwich, some 9 miles from the nearest outbreak in the Checkley series, and two days later it appeared 2 miles north of Stoke. Up to the 1st June there were 33 outbreaks within a radius of 5 miles of these two premises. In one of these, at Darnhall, disease had existed for 5 or 6 days before it was confirmed on the 16th May, and during that time milk had been sent daily to a dairy 12 miles away in south Cheshire. An employee at the dairy had been obtaining waste milk there to feed his pigs, and they developed the disease on the 24th May. There was also an outbreak in the stock of another supplier of milk to the dairy, this time at Coole Pilate. From these outbreaks there were 16 others within a radius of 5 miles. Isolated outbreaks occurred near Whitchurch, Chester and Tarporley, but how the infection came was not discovered. From the 6th April to the 3rd July, when the last of the outbreaks of this series was confirmed at Hatherton, there were 84 outbreaks in Cheshire.

26. Coinciding with the southward spread in Cheshire, an outbreak was confirmed in Staffordshire, near Market Drayton, on the 25th April. Here the infected animals had been treated daily for three days by two veterinary surgeons. As foot-and-mouth disease had not been suspected, the veterinary surgeons had visited 36 other farms in the Market Drayton district without wearing protective clothing, or doing any disinfection. The individual animals

they had treated were destroyed so far as they could be ascertained, but at least six outbreaks are thought to have resulted from the surgeons' visits. From the outbreaks so caused, local spread took place by both direct and indirect means, giving rise to 36 outbreaks within a 6 mile radius. At Hilderstone, Staffordshire, the disease had been in existence for at least ten days before it was notified on the 10th May. The origin of this outbreak was not discovered. Over 80 animals were found to be affected, and at least 18 outbreaks in the Hilderstone area were due to spread from this case.

Extension of the disease through markets

27. At the time the disease was at its peak in Cheshire, Staffordshire and Shropshire, the contaminated cattle transport lorry referred to in paragraph 25 infected the thirteen animals it was carrying to Kettering Market. Some of these animals eventually found their way to farms at Kettering and Barton Seagrave (Northamptonshire) and outbreaks occurred at both of them. Others were sent on to Northampton Market, and the stock they were in contact with there were later exposed for sale at Rugby, Stratford, Ullesthorpe and Banbury markets. The infection that was spread at these six markets resulted in 22 outbreaks.

28. In Derbyshire there were 11 outbreaks in this series. Two were spread from Congleton; another was thought to be an off-shoot from an infected farm in Staffordshire, and three others, at Mackworth and Buxton, were of obscure origin. These 6 outbreaks resulted in 5 others.

Wales

29. Disease was confirmed on an isolated hill farm at Padog in Caernarvonshire on the 3rd May. The veterinary surgeon who attended the ailing animals on the 1st May failed to recognise the disease, and he is thought to have conveyed it to a second farm in the neighbourhood. No definite connexion with disease in Cheshire was found, but a possible link was reported. Four bales of hay, delivered to the Padog farm about a week before the appearance of disease, came via a haulage contractor at Hightown, Lancashire. This contractor dealt with slaughterhouse waste from Liverpool abattoir where salvaged carcases from Cheshire outbreaks had been received. The contractor's employees who had handled the slaughterhouse waste had visited the hay shed.

Scotland

30. On the 26th April an outbreak was diagnosed at Turriff near Aberdeen. The origin was not at first apparent. Suspicion was, however, attached to two calves brought on to the premises on the 19th April from an Aberdeenshire dealer who had them as part of a consignment from a Chester agent. They came from a disease-free district of south-west England but they had been given a milk feed at Crewe Railway Station on the night of the 17th/18th April. The milk had been obtained from a milk factory at Basford which received supplies from herds around Crewe where disease was confirmed in the next day or two. It is reasonable to suppose that some of the cows in those herds were producing highly infective milk immediately before the disease showed itself and before the distribution of their milk was stopped. Although milk is ordinarily heat-treated at the Basford dairy, it is now known that untreated milk may have been sold for calf-feeding at Crewe Station. The evidence suggests that this did in fact happen. These calves were the direct cause of seven outbreaks; in Aberdeen (26th April), Perth (2nd May), two in Angus (30th April), Fife (7th May), the Isle of Mull (10th May), and Wigtown (13th May). In only two of these 7 outbreaks did the calves show classical symptoms of foot-and-mouth disease. In 4 of the remaining cases some of the suspect calves died without showing any recognisable symptoms. On two of the farms veterinary surgeons made a *post mortem* examination, but it revealed nothing which could lead to a suspicion of foot-and-mouth disease. Thus it was that on these premises the existence of disease came to be suspected only when, after another incubation period, recognisable symptoms were exhibited by contact adult stock. One

of the Angus cases gave rise to 5 secondaries through the sale of store cattle in Forfar and Stirling markets before disease was suspected. These were at Stirling, and in Clackmannan, Midlothian and Fifeshire. A single outbreak at Perth was believed to have originated through infection conveyed from the Fifeshire outbreak to Perth Market. There was one secondary to one of the Stirling outbreaks. The Wigtownshire case gave rise to 4 secondary outbreaks.

31. The first case of the exceptionally severe epidemic in Dumfriesshire was reported on the 2nd June in pigs owned by a dairy company at Holywood. The next day outbreaks occurred on two adjoining farms as well as at Lockerbie, some 10 miles away. The evidence available indicated that these three outbreaks were either spread from the Holywood dairy or had a common origin with the outbreak there. That origin appeared to be meat salvaged from the outbreaks at Wigtown which was sent via a Dumfries butcher to a school-meal kitchen at Marchmont, Dumfries. Kitchen waste found its way to a piggery (about half a mile from the dairy company's premises) where it was stored, unboiled, in bins in the open. Rooks abound in the neighbourhood, and it is known that they frequently fed from these swill bins. It is likely that they carried the infection to the dairy company, since there also the birds feed from feeding troughs in the open. Thirty-seven outbreaks followed in the vicinity of Dumfries.

32. No reason was found for the spread of infection to Lockerbie, where the first outbreak appeared simultaneously with the initial cases at Holywood. In another outbreak near Lockerbie it was estimated that the time of infection coincided with that of the first Lockerbie case some three miles away. Around these two cases there was local spread giving rise to 25 outbreaks in the Lockerbie —Lochmaben—Ecclefechan district.

33. There were two outbreaks north-east of Annan late in June and two soon after at Eastriggs. An unexplained move westward took the disease to Gretna where there was one case. An isolated case was confirmed at Canonbie 8 miles east of Ecclefechan. Spread of the disease in the Nith and Annan Valleys was attributed to the movement of rooks, game or vermin. It appeared also that there were visits by local stock-owners to farms where there were sick animals which afterwards proved to have foot-and-mouth disease. In the early stages of the outbreaks in Dumfriesshire there was a tendency to delay reporting. The district is heavily stocked, a fact which greatly favoured the spread of the disease and made control and eradication more difficult.

Cumberland

34. On the 1st July the first outbreak was confirmed in Cumberland, north of Carlisle. Although a link was not established with the cases then occurring across the Border in the adjoining county of Dumfries, it is probable that the initial Carlisle case was a spread from the nearest Dumfries cases at Eastriggs, some 8 miles away. A second outbreak on adjoining premises was diagnosed on the 7th July. Ten others occurred in the vicinity of Carlisle. Spread took place for which no explanation could be found ; to the east of the city, where there was one case ; to the south, where there were three ; and to the west, some four miles from the initial case, where there were two more. Three other Cumberland cases, the first of which was confirmed on the 9th July, were in a group at Gilsland, 16 miles distant from the nearest Carlisle outbreak. The owner of the farm on which the first outbreak occurred at Gilsland had visited another farm at Carlisle which was subsequently found to be infected.

35. A table showing the number of outbreaks in the various counties is attached at the end of this Appendix.

Virus Type O Outbreaks

36. In the series of outbreaks so far reviewed the virus was type A. There were, however, three groups of outbreaks in Berkshire, Bedfordshire and Gloucestershire (detailed below), in which the virus was identified as type O. They certainly could have had no connexion with the main series of outbreaks. But type O as well as type A was probably present on the Continent and may have been brought by birds or have been conveyed in some other way.

Berkshire

37. The first type O virus outbreak occurred at Winkfield, near Windsor, on the 21st November, 1951. Its origin was never discovered. The second occurred on contiguous premises on the 2nd December.

Bedfordshire

38. Three outbreaks from which type O virus was recovered were confirmed in February, 1952. Disease was first reported from a slaughterhouse at Luton, and later confirmed on the premises of a dealer at Hockliffe from which the infected animal had been consigned through Luton Collecting Centre on the 25th February. Three other animals from this dealer's farm were sent to premises at Tebworth, and were found infected there on the 28th February. Investigations failed to reveal the source of infection of the original case in this county.

Gloucestershire

39. Four type O virus outbreaks were confirmed near Cheltenham between the 19th August and the 1st September, 1952. The first reported case was shown to be secondary to disease on contiguous premises where it had existed for five to seven days. No explanation was found for the appearance of the disease in the initial case. There were two further secondary outbreaks locally.

NUMBERS AND DATES OF OUTBREAKS BY COUNTIES

(*14th November*, 1951–*4th November*, 1952)

County	Number of outbreaks	Date of first outbreak	Date of last outbreak	Type of Virus, if other than "A"
England				
Bedfordshire	3	26. 2.52	28. 2.52	3(" 0 ")
Berkshire	15	21.11.51	19. 6.51	2(" 0 ")
Buckinghamshire ...	1	6. 5.52	—	
Cambridgeshire	1	23. 3.52	—	
Cheshire	84	6. 4.52	3. 7.52	
Cumberland	15	1. 7.52	5. 8.52	
Derbyshire	11	1. 5.52	11. 6.52	
Devon	3	20. 6.52	17. 7.52	
Dorset	4	21. 5.52	21. 6.52	
Essex	8	14.11.51	7. 4.52	
Gloucestershire	4	19. 8.52	1. 9.52	4(" 0 ")
Hampshire	10	23. 3.52	6.10.52	
Isle of Wight	5	19. 5.52	30. 5.52	
Kent	49	10. 1.52	20. 9.52	
Leicestershire	8	18.11.51	25. 5.52	
Lindsey (Lincs.)	5	17.11.51	30.12.51	
Norfolk	34	15.11.51	6. 1.52	
Northamptonshire ...	8	2. 5.52	22. 5.52	
Nottinghamshire ...	1	16.11.51	—	
Oxfordshire	3	28. 5.52	5. 7.52	
Salop	19	1. 5.52	7. 6.52	
Staffordshire	57	14. 4.52	14. 6.52	
Suffolk East	45	15.11.51	19. 4.52	
,, West	7	22. 3.52	19. 4.52	
Surrey	1	25. 3.52	—	
Sussex East	40	18. 3.52	4.11.52	
,, West	16	27. 4.52	30. 9.52	
Warwickshire	9	3. 5.52	2. 6.52	
Wiltshire	2	29. 5.52	15. 6.52	
Yorkshire E.R.	25	14.11.51	21. 2.52	
,, N.R.	1	26.11.51	—	
,, W.R.	1	17.11.51	—	
	459			
Wales				
Caernarvonshire	1	3. 5.52	—	
Denbighshire	1	6. 5.52	—	
	2			
Scotland				
Aberdeenshire	1	26. 4.52	—	
Angus	2	30. 4.52	30. 4.52	
Argyllshire	2	10. 5.52	15. 5.52	
Clackmannanshire ...	1	2. 5.52	—	
Dumfriesshire	63	2. 6.52	13. 8.52	
Fifeshire	2	4. 5.52	7. 5.52	
Kirkcudbrightshire ...	5	12. 6.52	29. 6.52	
Midlothian	1	4. 5.52	—	
Perth and Kinross ...	2	2. 5.52	7. 5.52	
Stirlingshire	2	2. 5.52	12. 5.52	
Wigtownshire	5	13. 5.52	22. 5.52	
	86			
TOTAL	583			

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SOUTHERN ENGLAND GROUP
21 April 1952 — 4 November 1952

• Primary outbreaks
◦ Secondary outbreaks

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THE EVIDENCE ABOUT THE INTRODUCTION OF THE DISEASE INTO GREAT BRITAIN BY BIRDS

1. In the Report of the Foot-and-Mouth Disease Research Institute at Pirbright for the years 1937-1953 it is said:

> "The theory that foot-and-mouth disease might be brought to England from the Continent of Europe by migrating birds was advanced as long ago as 1923 by Sir Stewart Stockman, then Chief Veterinary Officer [of the Ministry of Agriculture and Fisheries]. In 1937 it became a controversial issue and aroused such public interest that an investigation was undertaken at Pirbright by the late Mr. Eccles. He showed that birds which had been artificially fed with virus-infected food excreted the virus up to about 24 hours and that their feet and feathers if contaminated might remain infective for at least 91 hours. However, further experiments, designed to test the possibility that birds which had been in contact with infected cattle might spread the infection to other susceptible cattle or swine, gave negative results except in one instance. The work failed to provide any strong evidence in favour of the hypothesis that birds constitute an important vehicle of virus transport in nature, but on the other hand did not rule out such a possibility."

2. The Ministry of Agriculture believe that, apart from infected imported meat, birds are the most likely cause of the primary outbreaks that occur in this country. In a memorandum they submitted to the present Committee they said: "Experience has shown that when there is much disease in the coastal regions of the Low Countries at the time of the autumn migration of birds, the livestock in eastern and south-eastern England are exposed to infection". They also drew attention to the fact that, as the disease moved westward in northern France during the 1951-52 epidemic, it also moved westward in this country.

3. Among the witnesses who thought it probable that the disease was brought to this country by birds were the Royal College of Veterinary Surgeons, the National Cattle Breeders' Association, the Royal Agricultural Society of England, the Counties of Cities Association and the Kent County Agricultural Executive Committee. Other witnesses thought that birds were only likely to cause local spreads of the disease. Dr. Galloway, the Director of the Pirbright Research Institute, thought that seagulls were more likely culprits than starlings.

4. The evidence available about the disease having been brought to this country by migratory birds is examined in an article by Mr. W. W. Wilson and Mr. R. C. Matheson, two of the Ministry's Veterinary Officers, which is reproduced as Appendix VIII (i). A memorandum by Colonel R. Meinertzhagen, Chairman of the British Ornithologists' Union, about the relationship between birds and domestic stock is reproduced as Appendix VIII (ii).

5. In Switzerland the view was expressed that birds might possibly be culprits, but that they could only spread the disease over short distances. In Belgium, starlings were suspected, and in Holland and Argentina spread by birds was regarded as possible. Although the Danish veterinarians thought that the virus was carried by the wind, they nevertheless suspected seagulls as well. The Norwegian veterinary experts were quite convinced that birds were not responsible for introducing the disease into their country. The outbreaks usually occur there in the late autumn when the wind is in the south and the seasonal movement of migrating birds is away from, and not to, Norway. Windborne virus from Jutland was thought to be responsible for introducing the disease to Norway. The Swedish veterinarians expressed similar views but nevertheless thought that an occasional outbreak might be attributable to seagulls and crows.

BIRD MIGRATION AND FOOT-AND-MOUTH DISEASE

Extract from an article by W. W. WILSON, M.R.C.V.S.
and R. C. MATHESON, M.R.C.V.S.
Veterinary Officers of the Ministry of Agriculture and Fisheries

Are migratory birds to blame for the introduction of foot-and-mouth disease into this country? If so, which birds are involved and what is the extent of their responsibility? In this article the writers examine the evidence at present available on the subject.

"The Bird Transmission Theory

The earliest reference to birds as vectors of infection seems to have been made by Mettam (1914) in a consideration of the possible origins of the Irish outbreak of 1912. He laid no special emphasis on birds in general but neither did he entirely rule them out of reckoning. Sir Stewart Stockman in his Annual Report for 1919 considered birds to be improbable carriers but thought the possibility of airborne transmission deserved further inquiry. In 1923, Stockman and Miss Garnett made an attempt to correlate bird migration between the Continent and Britain with the then unexplained primary outbreaks. They set out to establish a negative by endeavouring to eliminate rather than incriminate birds. No particular species was considered, the authors confining themselves to a general treatment of the subject and concluding "the circumstantial evidence as a whole is very far short of establishing a negative case." As, at that time, the role of the swill tub was not appreciated, conclusions of this nature were vitiated in advance. In 1942, Bullough published an extensive study on the relationship of starlings and foot-and-mouth disease. He gave an excellent resumé of the ornithological aspects of the case and then attempted to establish a *prima facie* case against the starling on purely statistical grounds, both as an agent in the autumn infections of this country and spring infections of the Baltic countries. Surprisingly enough, for it was then 1942, he also failed to appreciate the role of the swill tub and, with a limited understanding of the factors involved in the spread of the disease, was unable to assess correctly the value and meaning of his not inconsiderable data. Following a critical review of Bullough's paper by Dr. Landsborough Thomson in 1943, there does not appear to have been any further attempt to deal with the subject other than in the form of topical articles in the press.

The bird transmission theory was at one time the subject of some small-scale investigations by Eccles at Pirbright. There, great difficulty was experienced in clinically infecting wild birds. One starling was so affected but the disease did not spread to other birds kept in close contact. Again using starlings, it was found that birds infected by mouth excreted virus in their droppings from 10 to 26 hours after ingestion of contaminated material, but there was no suggestion that virus multiplied in the system of the bird. After external contamination of feet and feathers, virus was recovered up to a maximum of 91 hours. Birds exposed to natural infection and flown directly to healthy animals transmitted infection with one of three viruses. Birds similarly exposed to natural infection and then held in isolation for 4-5 hours failed to transmit the disease.

There is, of course, no possibility of reproducing these trials under completely natural conditions. It is highly probable that exposure to the diluting effect of air currents and rain results in some shortening of the viability of virus in external contaminations, but this could well be offset by the lower temperatures. Equally, removal of the fear complex in the natural state might reasonably be expected to prolong the period before complete elimination from the alimentary tract. For practical purposes we must assume that birds in their wild state do not become clinically affected with the disease or, in other words, do not become manufacturers of virus. But they may carry infection on their bodies for a time, probably measurable in hours, dependent upon the extent of the original contamination in relation to the prevailing weather conditions, and they definitely harbour infection for up to 26 hours after ingestion of contaminated material. Thus they are merely vehicles in the mechanical transmission of virus. On this basis, the role of any species of birds as potential vectors of foot-and-mouth disease can be assessed in mathematical terms as a function of their numbers, habits and opportunities for acquiring infection.

Birds have been blamed for the local spread of infection from known foci of disease in this country. Outbreaks in grazing stock, especially where outside trough feeding is practised, provide excellent conditions for external contamination of birds and for the ingestion of infective material. Reports from field staff on outbreaks in trough-fed sheep in downland country frequently comment on the large numbers of birds observed congregating around or on the flocks. In such circumstances the time involved in moving from one flock to another is only a matter of minutes. One cannot escape the conclusion that in field infections the mobility of birds makes them highly probable and dangerous disseminators of infection.

Bird Migration

On the wider question of introducing disease from the Continent, it is necessary to study the movements and species of birds which could be incriminated.

Our British birds may be divided into four groups:

1. Native species which remain within the confines of our shores at all seasons.
2. Native species which leave our shores for warmer climates each autumn and return in the spring.
3. Birds from the Arctic region, northern and central Europe and the Low Countries which winter with us to escape the rigours of winter in their breeding areas.
4. Birds as in group 3 which merely use this country as a port of call on their way to warmer climates.

The general direction of the autumn migration of species which affect Britain are shown in Fig. 1. In the main, the spring migration follows the autumn lines in reverse.

Fundamentally, the autumn movements of birds are the sequel to falling temperatures reducing the available food supply in their breeding areas, but throughout countless ages these flights have become such an integral part of the lives of the birds that they are now performed almost instinctively. It may be that the movement also serves a useful purpose as an application of nature's law of "the survival of the fittest", in that immature or weakly birds unable to make the journey would inevitably perish during the winter in the breeding areas.

Our autumn visitors come from two distinct sources conveniently considered as northern and east-west. The northern stream, originating from Iceland, Norway and Arctic Europe, strikes our shores in the Shetlands, Hebrides and from Cape Wrath to the Humber Estuary. Some portion of the stream remains to winter in coastal or inland areas, but the majority skirts our coasts in a general southerly direction on their way to more temperate climates.

The east-west stream is drawn from the Baltic area, Central Europe and the Low Countries. Migrants from Central Europe travel down the river valleys of Germany to join birds from the Baltic and then skirt the coastline in a south-westerly direction to the Low Countries, where they may congregate in great numbers before making the sea crossing. Given favourable weather conditions, groups of birds may make a direct crossing to England from the Friesian Islands, and even from Denmark, but the majority follow the coastline to the estuaries of the rivers Rhine, Maas and Scheldt, thus ensuring the comparatively short sea crossing.

Except when made as a sequel to sudden changes of weather, autumn migration is a fairly leisurely process. Daily journeys over land may amount to no more than 50 miles, so that the major part of each day is available for foraging. Sea crossings are made at a speed of 30-40 miles per hour. Thus birds may travel from Holland to Norfolk in 3-4 hours or to Lincolnshire in 6 hours.

Flight over water is generally directed due west, and the greater mass of the birds strikes our shores between Norfolk and the Thames estuary, with smaller numbers making landfall as far north as Lincolnshire. The majority penetrate inland and remain with us throughout the winter. Some, which have gone inland in the region of the Thames estuary, make a short overland journey to join with a stream skirting the Kent-Sussex coast and either continue

on to winter quarters in Ireland or cross back to France. Weather conditions have a definite bearing on migration. Unusually mild or cold spells may delay or hasten the departure of birds from their breeding areas. High winds and rainstorms may hold up the sea crossing, so that large hordes of birds congregate in the normal areas of take-off, ultimately arriving in spectacular waves or "rushes". Adverse winds may tire migrants to such a degree as to affect the depth of their initial penetration into the country. In the same way, cross winds may blow birds off their normal course, with consequent landfalls at unusual points. In average years migration commences towards the end of September, rises to a maximum in the third week of October and is practically finished by the third week in November.

Fig. 1. Map showing the principal migration routes of birds to the British Isles.

Later migrations on a much reduced scale may take place at any time during the winter months. These are not really migrations at all but rather hard weather movements of birds which would normally winter on the Continent, being forced to seek warmer quarters by extremes of cold or snow.

There is nothing in previous records to suggest that the spring migration of birds has been responsible for introducing infection into Britain. No doubt, several factors contribute to this position. Continental epidemics of foot-and-mouth disease tend to peter out during the winter months; housing of cattle on both sides of the Channel lessens the possibility of infection being picked up; birds have to make a longer sea crossing than their autumn counterparts; and last and most important, the spring movements of birds, being the result of a physiological urge, are performed in small groups and much more rapidly than the relatively leisurely autumn journeys where hordes of birds dally and feed frequently on the way.

Likewise there are no grounds for suggesting that disease has been introduced in the autumn by birds of the northern stream. Foot-and-mouth disease has rarely been confirmed in their areas of origin and certainly never in epidemic form. The majority of northern birds which winter with us do so in Scotland and Ireland, where primary outbreaks of undetermined origin are rare.

Bird Species in the East-West Migration

Having reviewed bird migration in general, and eliminated two of the three movements from further consideration, it is now necessary to study those species in the east-west stream which, on account of their habits and numbers, might be responsible for the autumn introductions of the disease into this country. A large proportion of our autumn visitors arrive as immense mixed flocks of rooks, jackdaws, starlings and skylarks. These four species are all essentially

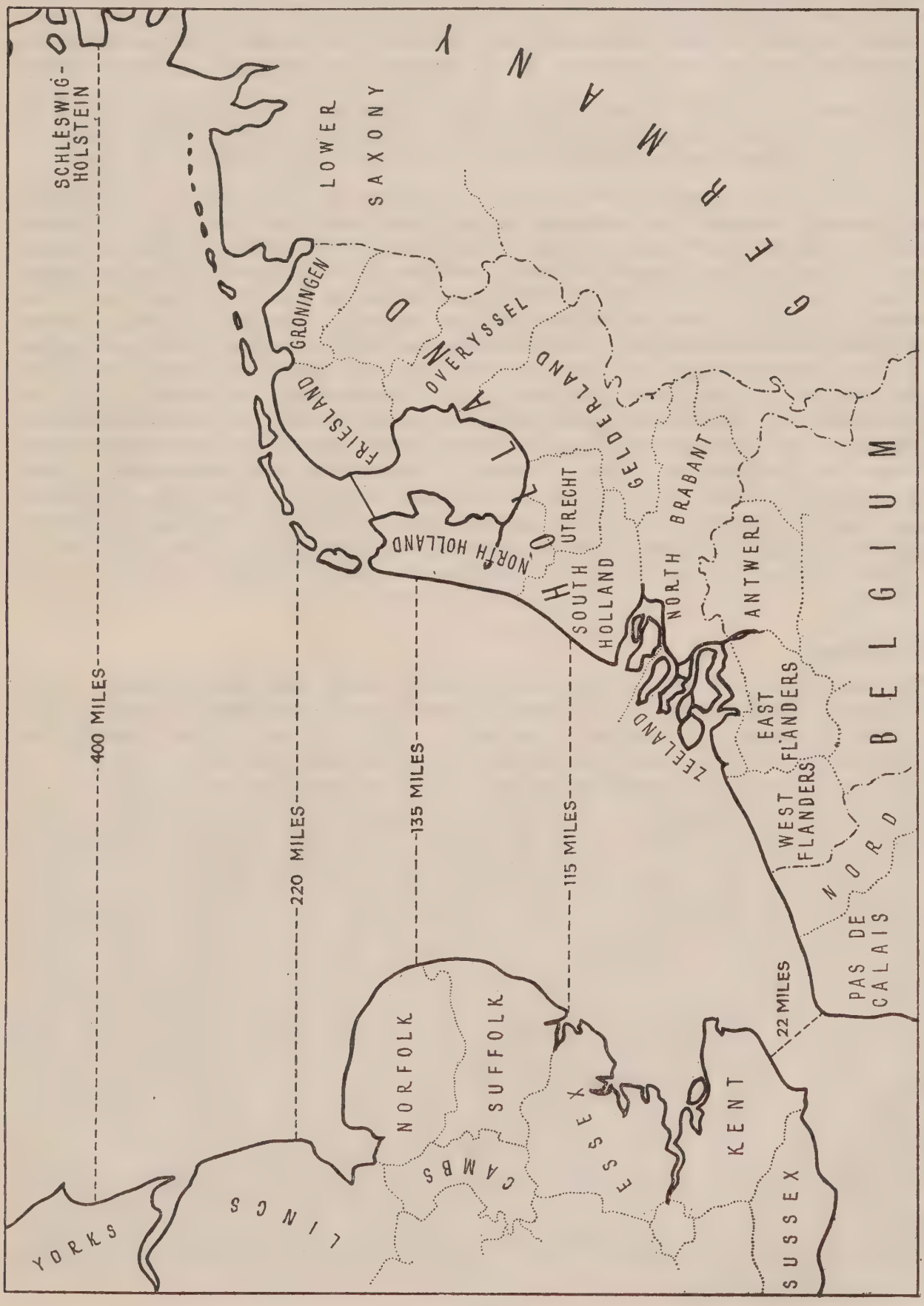

Fig. 2. Distances travelled by migrating birds using the east-west route, showing also the relationship of coastal areas.

pasture feeders and thus have continuous opportunities for contact with grazing stock. As potential disease carriers, the differences between them are only a matter of degree based on their habits and numbers. Skylarks appear to avoid animals, rooks and jackdaws do not avoid but rather ignore them, whilst the starling appears to make a special point of keeping close to grazing stock.

Continental lapwings arrive with the mixed autumn "rushes", making landfall from Yorkshire to Kent to winter very largely in the Humber and Thames estuaries. This species, in company with skylarks, also takes part in the winter hard weather movements from the Continent.

Wood-pigeons use the east-west route but are of less importance than most species, in that they do not regularly frequent pasture-land.

Wild ducks, chiefly mallard and teal, come to this country from the far north; many winter on the Continent. The Continental birds, however, may be forced by severe weather to seek shelter on the mud flats and marshes of the south-east coast, where contact with cattle by way of drinking pools might readily be made.

Wild geese, particularly grey geese, migrate similarly to ducks and they also adopt winter migration when the marshes of the Baltic and Dutch coasts are frozen. Grey geese feed regularly on pastures and do not penetrate far inland.

Gulls of various species are common residents in this country. Following their breeding season, they migrate to the coast and with the onset of colder weather tend to move southwards, where they are joined on the south-east coast by Continental visitors. Stormy weather at sea drives the gulls inland to roost in sheltered bays, inland lakes and secluded fields and marshes. The number of birds in a roost may be enormous, as in the case of Littleton reservoir in Middlesex when the largest estimated total in 1940 was 45,000. Larger species of gulls are carnivorous and are great scavengers. Rubbish dumps, especially those containing waste food products and possibly meat and bones, are commonly visited by swarms of gulls, while ships in harbour or in coastal waters are besieged by gulls waiting to devour any waste foodstuffs. Undigested food is voided in the form of pellets, commonly found near the roosts and in fields and marshes. From their frequent and indeterminate wanderings in coastal areas, their propensity to feed on garbage and ship's swill, and their ability to regurgitate undigested food, it would seem fair to assume that gulls might readily constitute a direct vehicle in the transmission of disease to cattle and sheep from infected swill.

The Starling

The association of the starling with grazing stock and their pastures which has already been noted, is a matter of common knowledge to anyone with practical experience of livestock husbandry. Starlings are almost omnivorous, but under normal conditions live largely on insects and molluscs. They tend to keep closely together in flocks which move over the pastures excavating for food particularly in the immediate vicinity of grazing animals and frequently within inches of their noses, almost as if the process of grazing was exposing suitable food material for them. It is not an uncommon sight to see starlings perched on the backs of cattle and sheep. In winter, when the ground is frozen or snow-covered, starlings flock in the vicinity of houses and farms, and groups of them enter cattle yards in search of grain or other edible material. No other British bird, whether native or migrant, shows such an affinity for close contact with livestock as does the starling. When ground is contaminated with infective saliva the chances of picking up infection or otherwise becoming contaminated need no elaboration. Starlings have a further feature distinguishing them from most other species which may have a bearing on their disease-spreading propensities. During the hours of darkness migrant starlings roost communally in tall buildings in cities, in woods, in hedges and in reed beds which soon become heavily contaminated with their droppings. During the day they sally forth to feed in numerous small flocks, returning to the same point each evening. In roosts, which may contain up to 50,000 starlings, the birds are huddled so closely together that infection could readily be transferred from bird to bird. As to numbers, the starling is the greatest single factor in the east-west stream. Moreover, its numbers are thought to have increased substantially during this century and to be still increasing.

Summarizing the foregoing on the basis that birds are mechanical vehicles in the transmission of virus, the starling by its habits and numbers is an obvious choice as chief suspect. This, of course, does not imply that other species can be entirely ruled out, but merely that their role is likely to be incidental to any played by the starling.

Comparison of British and Continental Infections

In General

Applied to birds on migration, the habits and numbers of any of the species previously considered remain a fairly constant factor from year to year, the only variable being the degree of exposure to infection. Thus if birds are to be incriminated for introducing infection, we should expect to find a definite correlation between the extent of infection in certain areas of the Continent and the number of primary cases along our east and south-east seaboard. Looking over the records of British and Continental infections since 1890, it is at once obvious that, apart from the years 1922-24 when the disease almost got out of control in this country, fluctuations in the incidence of disease in Holland, Belgium and the Pas de Calais area of France show a remarkable degree of similarity to the position in Britain. This is just as might reasonably be expected as, until the Importation of Carcases (Prohibition) Order came into operation in 1926, we were regularly importing potentially infected carcases from these countries.

Since 1926, inquiries into the origin of all outbreaks have been conditioned by the knowledge that infection may have been introduced through the agency of chilled meat products from abroad. We have been assisted in this by our ability to classify viruses by typing. Since 1930, with the exception of a short period in the early part of the second World War, material has been submitted for typing from every outbreak not obviously connected with previous centres of disease, and has served a very useful purpose in correlating or separating the origins of parallel infections. This was particularly well demonstrated in the 1951 series of outbreaks when one geographically isolated case in Berkshire was typed as group " O ", whilst material from some twenty parallel cases in the eastern counties were all group " A ".

To determine the origin and status of any outbreak, it is essential to have individual case records. As available records date from 1937, further comparison will be limited to the period since that date. Table 2 gives comparative figures

Table 2

Year	Total Number of Outbreaks									Primary Outbreaks in 8 Coastal Counties of Britain
	Holland			Belgium			Pas de Calais			
	Sept.	*Oct.*	*Nov.*	*Sept.*	*Oct.*	*Nov.*	*Sept.*	*Oct.*	*Nov.*	
1937	11,444	37,998	31,230	4,090	14,098	22,321	(Epidemic)			20+
1938	34,905	39,623	17,257	3,642	3,816	4,960	191	37	68	7
1939	17,925	13,198	3,818	775	1,199	2,333	801	214	81	3
1940	66	53	34	1,758	1,027	547	(Occupation)			1
1941	2,492	2,191	904	141	105	67	125	93	59	—
1942	301	309	1,917	9	9	7	3	1	5	—
1943	9,708	7,618	2,605	—	2	6	1	—	1	1
1944	3,933	6,183	4,085	1,132	1,411	967	—	1	—	—
1945	28	38	73	2	2	23	—	—	—	—
1946	4,596	4,587	3,183	1,076	2,136	3,009	2,451	1,947	1,184	7+1*
1947	8	3	2	3	2	2	—	2	2	—
1948	17	48	339	448	773	272	406	563	458	3+1†
1949	200	245	324	14	6	3	50	14	19	2
1950	102	148	170	2	—	34	—	5	2	—
1951	109	3,485	12,357	47	6,261	23,613	15	27	196	20+

* Includes one case in Herts.

† Includes one case in Wilts.

Note.—We have been warned that the Continental figures for 1940–45, i.e., the occupation years, are possibly exaggerated, as a report of foot-and-mouth disease was the invariable excuse given to the occupying authorities when inquiring into reduced farm output.

of total outbreaks for the months of September, October and November in each year since 1937 for Holland, Belgium and the Pas de Calais area of France and also the number of primary outbreaks in the south-east coastal counties of Britain.

Comparable figures for Denmark and Germany are not detailed, as they appear to have little or no bearing on British infections. For example, Denmark had only two outbreaks in the period September-November 1937, when we experienced a major invasion. In the same months of 1938 Denmark had 69,883 outbreaks, whilst we had only three cases in the eastern counties. Again, in 1951, Western Germany, and especially the coastal provinces of Schleswig-Holstein and Hanover, experienced a very severe epidemic during the months of September and October, yet Britain remained free.

Table 2 indicates that there is a definite correlation between the disease position on the opposite shores of the shorter crossings of the North Sea. In seasons of high Continental incidence our figures move up in sympathy, and conversely we may escape entirely when overseas incidence is low. The monthly totals given are those for the whole of Belgium and Holland. The regular disease bulletins issued by their Governments detail the outbreaks of disease in the various sub-divisions or provinces of each country. Comparison of the dates of our primary south-east coast infections with such of these records as are available reveals that the danger to Britain is greatest and in fact only exists when disease has attained definite proportions in certain coastal provinces: in Belgium, the provinces of East and West Flanders; in Holland, the provinces of South Holland, North Brabant and, to a less degree, Sealand. These are the areas where the major part of our autumn visitors congregate before starting the sea crossing to our shores.

In 1937 and 1951 figures suggest that the risk is greatest on a waxing infection, which is in accordance with the accepted tenet that the infectivity of a virus is greatest in the earlier stages of an epidemic. That the coastal provinces of Belgium and Holland and the Pas de Calais zone of France are statistically the areas of menace to this country might be said to be a normal expectation. It does, however, restrict the potential danger zones to a much smaller area of the Continent than had previously been believed.

In Recent Years

The contention that the risk of introduction of disease by migratory birds is determined by the degree of infection in the areas of take-off for their sea crossing gains a large measure of support from the following table:

Table 3

Total Outbreaks of Foot-and-Mouth Disease in Belgium and Holland

		July	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Jan.*
1937	...	12	711	15,534	52,096	53,561	37,829	12,011
1951	...	32	31	156	11,459	35,920	22,802	

In the 1937 series, disease first appeared on October 16 in Norfolk, with further primary strikes in that county, Lincolnshire, Suffolk and Essex before the end of the month. But in 1951 disease did not occur until November 14, that is, twenty-nine days later than in 1937. Examination of meteorological records fails to show any reason why migration in both years should not have been a continuous and unchecked process throughout the normal period. The autumn of 1951 was unusually mild, which may have resulted in some birds coming over later than usual and maybe after the end of the normally accepted migration period, but migration is such an ingrained instinct in birds that in the absence of adverse flying conditions it appears reasonable to assume that a comparable number of birds would have made the sea crossing by the same dates in each year and that the later appearance of disease in Britain in 1951 was entirely due to the later date of the build-up of disease in the Low Countries.

In dealing with an infection so highly contagious as foot-and-mouth disease, it is a matter of some difficulty to arrive at a decision as to which are primary or secondary outbreaks in invasions of this nature. It is accepted that as soon as symptoms of disease appear in any animal in these islands the risk of lateral spread is immediate. Making due allowance for this and other possible

factors in the dissemination of virus, the primary outbreaks in the early stages of both invasions have been plotted in Fig. 3.

These indicate that in 1937 twenty-three primary outbreaks occurred in the period October 16 to November 9, involving all the coastal counties between Lincolnshire and East Sussex. Assuming the time interval from infection to confirmation of disease to be six days, then virus was being introduced into this country between October 10 and November 3, which coincides with the period of maximum extension of disease in the Low Countries in that year and also with the normal peak period of migration. All materials sent for typing were of a common strain "O" and identical with the type then decimating Continental herds. The 1951 series started in a more explosive manner with twenty primary cases in the seven days November 14 to 20. No cases occurred south of the Thames estuary, but there were no less than five north of the River Humber, an area not generally regarded as a major landfall for birds taking the east-west migration route. This may be explained by the constant south-west winds which prevailed during most of the autumn diverting birds northwards off their route with resultant landfalls further up the east coast. Using the same yardstick of six days from infection to confirmation of disease, the major crossings of the North Sea necessary to give rise to the 1951 infections would take place between November 8 and 14, a period accepted

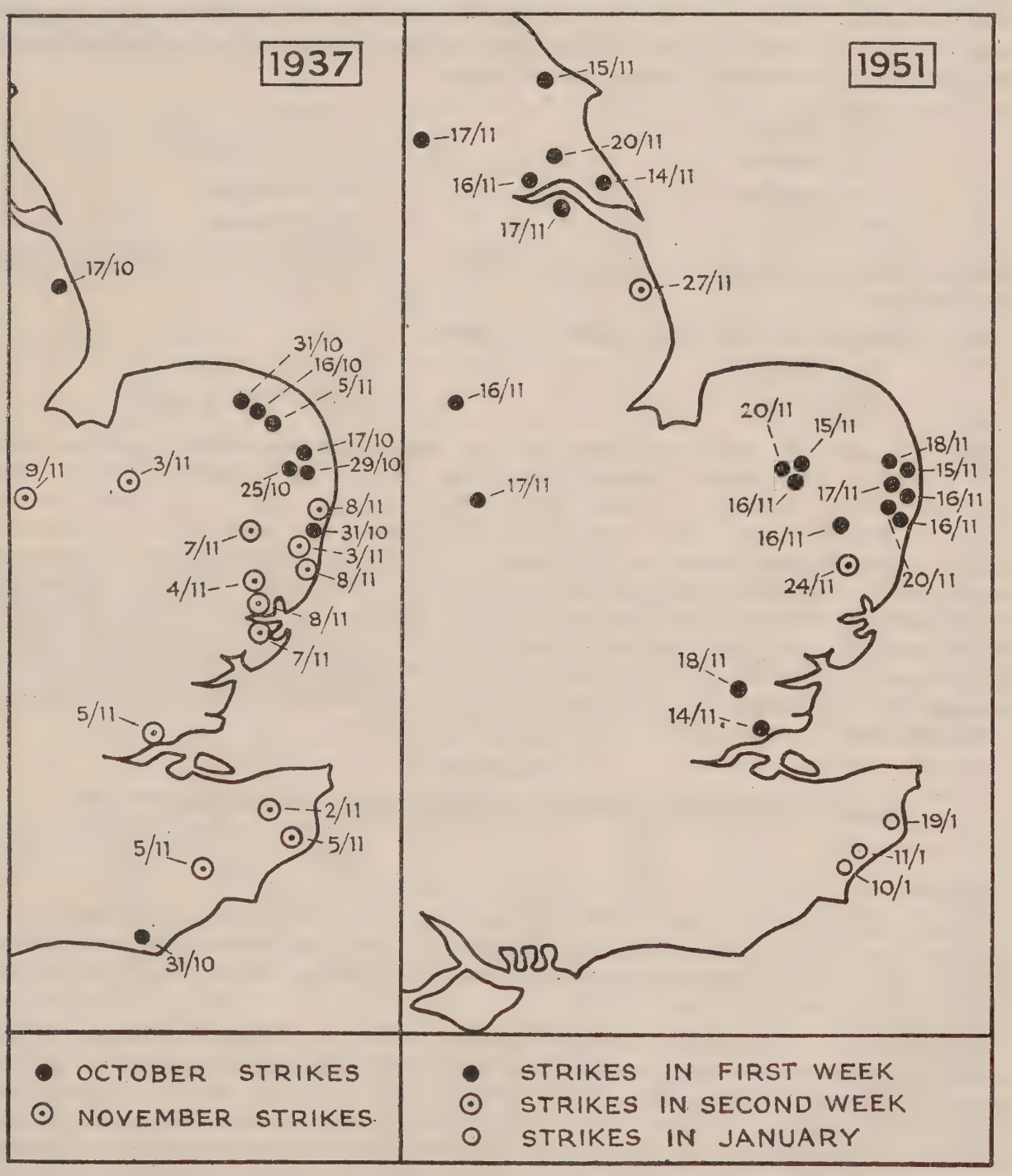

Fig. 3. Location of primary outbreaks ("strikes") of foot-and-mouth disease in England in the early stages of the invasions of 1937 and 1951.

by ornithologists as within the normal migration range. With the exception of the Berkshire case previously noted, all materials sent for typing were returned as strain "A", again identical with the type current on the Continent.

There can be little doubt that in both years further primary strikes occurred at dates later than those shown in Fig. 3, but secondary cases arising from original centres of disease progressively confuse the general picture until a point is reached where one is not justified in attempting to establish primary strikes, except in very isolated cases. In the 1951 diagram only two such cases are indicated, but undoubtedly there were others. Reports from the field staff in both years stressed the large number of birds seen on infected premises or which had recently been noted on these premises. In nearly every instance the emphasis was on starlings.

As a continuation of the 1951 series, three primary outbreaks were confirmed in Kent between January 10 and 19, 1952. These, the first cases south of the Thames, are of particular interest since they coincided with a definite extension of the Continental epidemic into the Pas de Calais area of France. We have already made passing reference to the close parallel between British primary infections and the disease position in the Pas de Calais. During the five years 1941-45 the Pas de Calais was virtually free from infection. In that period the only primary autumn case in the south-east coastal counties was in Norfolk in 1943, at a time when Holland was experiencing a moderate epidemic. In 1946, however, when a wave of infection in the Low Countries was especially concentrated in the Pas de Calais, eight primary cases in grazing cattle were confirmed in south-east England as follows:

18.10 Dorset	4.12 East Sussex
9.11 Suffolk	11.12 Hertford
23.11 Suffolk	19.12 Dorset
24.11 Kent	25.12 Dorset

Material from every case was typed as "O"—the same type as prevailed across the Channel.

The sequence of the 1948 outbreaks was:

4.11 Wilts	23.11 Norfolk
23.11 Hants	19.12 West Sussex

Again, all were in cattle on open grazing and again, all were typed to strain "O", as was the parallel French infection. It will be noted that south coast infections have tended to occur rather later in the year than those in East Anglia. The January, 1952, series in Kent follow the same trend. However, Fig. 3, with its comparison of 1937 and 1951 primary cases, shows four strikes south of the Thames between October 31 and November 5, 1937. Although, unfortunately, we have not detailed French disease figures for 1937, the spread of the epidemic in that year was from France into the Low Countries, and at the relevant period the Pas de Calais was experiencing a major epidemic. Conversely, in the autumn of 1951 the disease spread relatively slowly from the Low Countries into France as the following figures show:

Table 4

Number of Outbreaks of Foot-and-Mouth Disease in Pas de Calais, 1951-52

Period to	15/9	30/9	15/10	31/10	15/11	30/11	15/12	31/12	15/1
Outbreaks	—	4	6	21	33	143	276	333	619

Again using the yardstick of six days from infection to confirmation of disease, the time of contraction of infection in the Kent outbreaks was between January 4 and 13. The maximum expansion of disease across the Channel was in the period January 1 to 15.

The sequence of events in the Channel area in December-January gives additional support to the previous contention that the prime essential for the spread of disease to this country is a certain level of infection in an appropriate area of the opposite shores. We appreciate that the period covered by this inquiry is not sufficient to justify any opinion being expressed on the apparent tendency for south coast outbreaks to occur later in the year than those in East Anglia. The impression may prove to be ill-founded but if correct may be

due to later migrants making use of the shortest sea crossing in the Pas de Calais region or to hard weather movements of birds.

The Time Factor

Only one general point remains for consideration—the influence of the time factor. Experimental work by the Foot-and-Mouth Disease Research Committee established the capacity of the virus to remain viable under optimum conditions for as long as four months. Eccles's work at Pirbright gave optima of 91 hours for external and 26 hours for intestinal contaminations of birds. We have no means of assessing whether these times are maintained under natural conditions. Whether external or internal contamination of birds is the more probable means of carrying infection is a matter for future experiment. For the purposes of this article we accept both methods as possible.

Statistically, the danger areas are within 5-6 hours flying time of any of the normal landfall areas of our east coast. Migration from these areas is made in daytime and at a season when there are at least 10 hours of daylight. Even on the longest sea trip from Holland to Yorkshire, there is ample time for birds to feed both before and after the crossing and thus to have contact with animals in both countries in the same day. But the shorter the sea crossing the less will be the effect of rain and air currents in diluting surface contamination on a bird and of virus being eliminated from its alimentary tract, and consequently the greater will be the chance of viable infection being left on pastures, feeding troughs or on animals themselves.

That a time factor applies is obvious from the proximity to the coast of most initial strikes. It is not possible to say how far inland migrants penetrate before making a landfall. Doubtless this is largely determined by prevailing winds. But it is accepted that the majority of birds having made the sea crossing do not remain in coastal areas more than a day or two. The comparative absence of primary outbreaks in the Midland counties suggest that no great number of birds make a deep initial penetration of this country and also that they quite quickly became clear of infection. Applied to Continental migration, this would explain why birds coming from or crossing the heavily contaminated region of Schleswig-Holstein and Hanover in September and October, 1951, did not bring disease to Britain; they "cleaned up" in Holland, probably leaving disease in their wake. Likewise, Low Countries birds in November, 1951, passing to the Pas de Calais would "clean up" in France before making the Channel crossing.

Conclusion

We have endeavoured to assess impartially the various factors having a bearing on the theory that birds on migration have been responsible for the introduction of foot-and-mouth disease into Britain. The seasonal incidence and location of primary outbreaks in the east and south coastal counties of this country shows a striking parallel to the period of autumn migration of birds and their area of landfall. We conclude that available evidence is adequate to establish a *prima facie* case against birds, and especially starlings on migration, as a means whereby foot-and-mouth disease is introduced into Britain; further that the frequency of its introduction is dependent on the extent of the disease in certain coastal areas of the Low Countries and north-east France at the season of bird migration.

Note.—Since this article was prepared there have been further outbreaks of foot-and-mouth disease in the spring and summer of 1952. Many of these occurred in the southern coastal counties of England. At the same time there has been a build-up of infection in the northern coastal counties of France unprecedented in extent for the time of the year. The evidence suggests that in 1952 for the first time the spring migration may have been responsible for introducing infection into this country. Moreover, the continuance of further cases in the coastal counties throughout the summer while the intensity of infection in Northern France was still increasing raises the question whether in certain circumstances it is not possible for infection to be carried by cross-Channel movements of birds which are not part of the regular migratory movements."

THE RELATIONSHIP BETWEEN BIRDS AND DOMESTIC STOCK

Memorandum by Colonel R. Meinertzhagen, Chairman of the British Ornithologists' Union

In the farmyard

1. Sparrows, chaffinches, yellow buntings, and greenfinches are the commoner birds found in farmyards. They have direct access to swill, but as these species, when in farmyards, are invariably the resident birds and not migrants, they do not fly from farm to farm but would normally attend that farm throughout the season. The migrant flocks of these species might be found around ricks but normally feed on stubble or other arable land and not in farmyards. They would not be in the vicinity of cattle grazing in pasture.

2. It is therefore clear that if these small passerines carry infection, it is not carried from herd to herd but is confined to that particular herd which uses their farmyard.

In pasture

3. Domestic stock on pasture are attended by starlings, jackdaws, green plover and golden plover; in the summer months by various wagtails. Skylarks are an abundant migrant to Britain but feed on ploughed land. Though breeding in pasture, they rarely settle on pasture in winter; risk of infection from skylarks would be negligible. In many parts of the British Islands large flocks of sea-gulls form close-packed roosts on pasture and rest on pasture when the tide is high and their feeding grounds covered.

4. Direct contact between birds and domestic stock is rare. Starlings, jackdaws and magpies are known to use cattle, horses, donkeys and pigs as perches; there is no proof that they use domestic stock for any other purpose such as searching for external parasites; but both starlings and jackdaws have been seen preening themselves and wiping their mandibles on the hair of cattle.

5. Of these migrant pasture birds, the jackdaw is a very scarce visitor from the continent and can be ruled out as a vector of foot-and-mouth virus. The golden plover visiting this country come from high ground on the Continent and do not breed in areas where foot-and-mouth disease is endemic, though if they rest and feed in the Low Countries before crossing the North Sea they could pick up infection. But both green and golden plover have remarkably clean legs, feet and bills; it is very rare to find these parts anything but spotlessly clean. The same applies to sea-gulls, whose legs are constantly in salt water.

6. Neither plover nor sea-gulls approach starlings in numbers; they are also much more restful birds than starlings and will remain in the same field or group of fields for days if undisturbed. Starlings, on the other hand, are most restless, seldom remaining on the same feeding ground for more than a few hours and then moving considerable distances in search of new grounds. The starling also almost invariably has both mandibles and legs soiled by mud and soil. His plumage, also, is never so immaculate as is always the case in plover and sea-gulls. This is partly due to the slum-conditions of starling roosts which are so crowded that fæces drop from one bird to another throughout the night.

7. For these reasons, if birds are vectors of foot-and-mouth virus, I regard the starling as suspect No. 1 and in the following notes have concentrated on that species. I am assuming that foot-and-mouth virus is viable for at least 24 hours on or in a contaminated bird, that it is not air-borne and that birds are not the manufacturers of the virus, merely the carriers.

8. If land has been contaminated by starling-borne virus, every animal passing that way, whether pheasant, partridge, rabbit, human or dog becomes a potential carrier.

Breeding distribution of starlings

9. British Islands. One hundred years ago the starling was not so abundant as a breeding species as it now is. It has bred for centuries on many Scottish islands and on the west coast of Ireland, but has recently spread throughout the Scottish mainland and now breeds sparingly in all Irish counties but is still scarce, especially in the west. It did not reach Ireland before about 1840, when three pairs nested near Belfast between 1844 and 1845.

10. It has for long been an abundant breeding species throughout England and Wales, including the Scilly Islands. It is only during the last 150 years that they bred in Devon and West Wales.

11. Continent. Starlings breed almost throughout Europe from 70 degrees north in Scandinavia, throughout northern Finland, south of 65 degrees in Russia and south to southern France, North Italy, and the whole Balkan Peninsula.

12. In Asia they breed east to Lake Baikal and south to Asia Minor, northern Iraq, Persia, Afghanistan, Kashmir and Sind.

13. There are resident populations in the Faroe Islands, Azores, Sardinia and north-west Africa.

Flight velocity

14. The normal cruising speed of starlings is just over 40 miles an hour with a possible acceleration to 48 m.p.h. if necessary.

Behaviour of migrants on arrival

15. I have observed starlings arriving on the Norfolk Coast on two occasions ; on the first occasion, in October, they landed at once and commenced to feed in Suaeda bush near the coast. On the second occasion four flocks arrived about 8 a.m. and flew on inland. The desire for food must depend on the distance birds have come, and this is not always ascertainable.

16. On another occasion at Dungeness I watched starlings coming in from the south at about 9 a.m. in April. They landed at once and fed.

Flight distances

17. London starlings roosting in Trafalgar Square probably travel from five to ten miles before they find suitable feeding grounds. In the country, it has been ascertained that flocks will fly as far as thirty miles for food. In Sinai flocks fly at least 25 miles twice a day to and from feeding grounds. The total area drawn upon for a large Lancashire roost was thought to be 250 square miles.

18. If a flock disturbed when feeding flies off, it seldom travels more than a few hundred yards but if shot at it will go several miles.

Movement and migration

19. Starlings are essentially gregarious except whilst actually nesting. But even during that period a few non-breeding birds remain in flock.

20. So soon as young are fledged they form flock and wander the country for food, often accompanied by parents.

21. Local movement begins as early as the first week in June in the British Islands. Whilst most of the British population is more or less resident, from late July to the end of September a few cross the English Channel by night or very early morning. Throughout the winter slight movement has been observed along the whole south coast of Britain, both crossing to France and return passage back to Britain. This latter has been observed even in autumn off Dover and Folkestone.

Autumn immigration from Central Europe

22. This commences in the last week in September, rarely earlier, increasing throughout October and almost ceases in early November. The vast majority of flocks arrive on our coast between Yorkshire and Kent. Many of these birds winter in Britain, whilst others cross to France and many cross to Ireland, arriving on the Wexford coast in the last half of October and throughout November. Movement has been observed in autumn from N.E. France to Kent.

Autumn immigration from North-West Europe

23. Most starlings leave Norway in October (when they commonly strike lighthouses) and Sweden in late September and during October. These birds reach our coast from the Shetlands to the Humber, but north of Fair Isle passage is rare. They arrive late at night or in the early morning. Birds disperse over the British Islands. They also enter Ireland—on the north and north-east coast—arriving from the area stretching from Galloway to the Hebrides.

24. At the end of October, flocks have been seen at sea 300 miles west of the Isles of Scilly and 500 miles N.W. of Cape Clear, S.W. Ireland.

25. The populations of Shetland, Fair Isle, Orkney and the Outer Hebrides undertake only local movement and are not believed to migrate.

Spring immigration from Southern Europe

26. This passage probably includes both British and continental populations. This commences in late February on our south coast and continues till late April, the birds arriving by night or in the early or late morning. They arrive on the south-east coast of Ireland from the third week in February to the middle of April.

Spring emigration to Central Europe

27. This takes place from mid-February to the end of March and has been observed from the Wash to the mouth of the Thames by daylight.

Spring emigration to North-West Europe

28. This movement occurs by night during March and April and has been chiefly observed in Orkney, Shetland and the Outer Hebrides. In Norway birds arrive singly or in very small parties in March and in larger flocks in early April.

29. Figure 1 shows, on the evidence of ringed birds, the source of wintering starlings from all over the British Islands. Figure 2 shows, on similar evidence, the wintering areas of birds of other countries.

Fig. 1

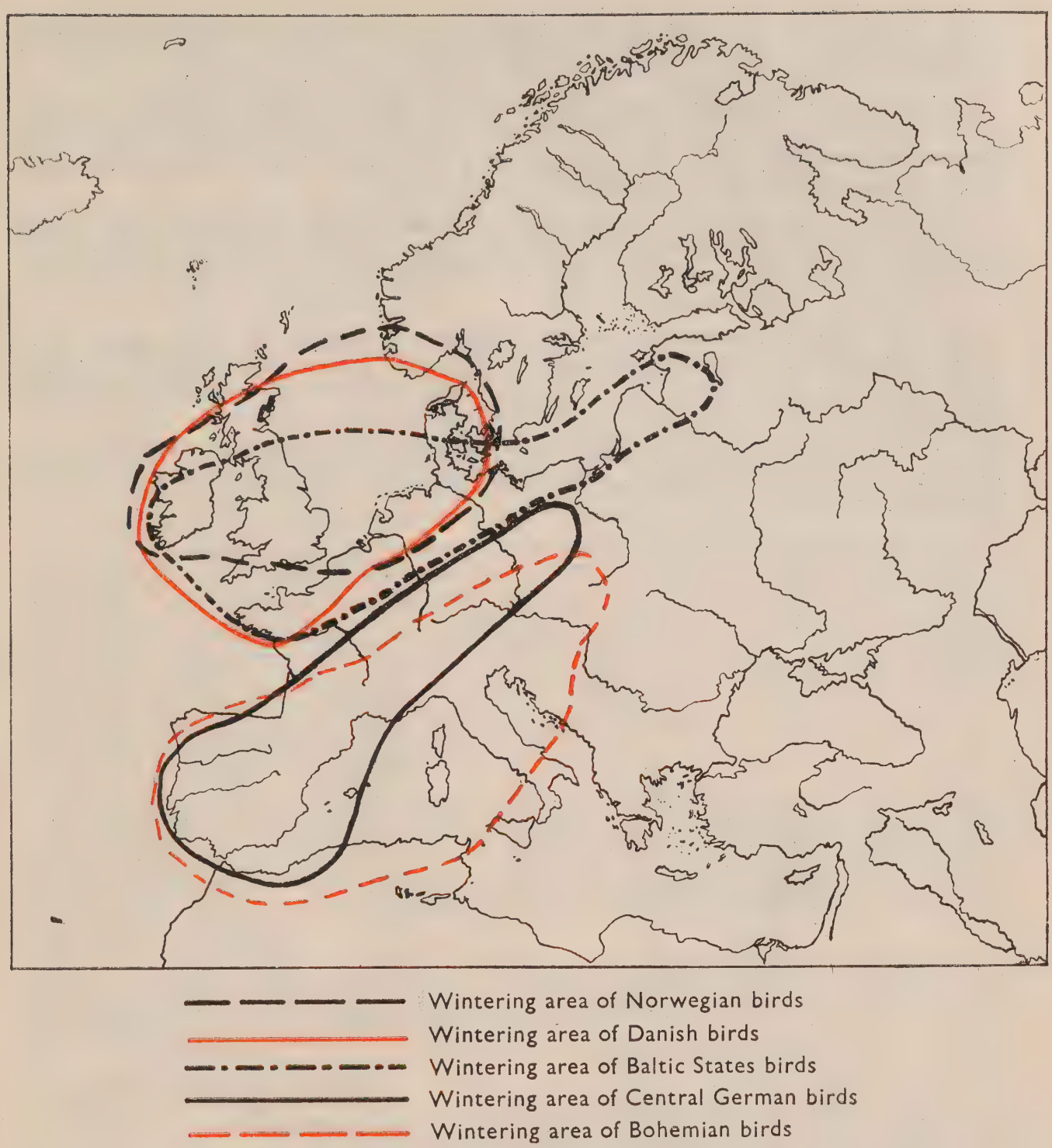

Fig. 2

Lines of flight

30. The lines of flight of migrating starlings have often been depicted on maps; these are all inaccurate, based on speculation, and misleading as none of them take into account weather conditions at the time of migration.

31. Birds cannot predict weather conditions; all they can know is the state of the weather at the point where passage commences; anti-cyclonic conditions are the most favourable for passage. If passage is across the sea, flocks may meet adverse or favourable winds which will divert them from their intended course.

32. It is established that birds can orientate themselves by daylight, but in bad visibility, in fog or heavy rain, without landmarks, migrating flocks are at the mercy of the elements, and they lose direction and drift. Birds endeavour to follow coast lines, river beds, etc., and usually cross seas at their narrowest parts.

33. Migrational drift due to side winds has a very great influence on migrational landfall. Take two hypothetical cases in Figure 3. The Triangle of Velocities, well known to airmen, can be applied to migrational drift.

34. The black triangle ABC, represents a flock leaving southern Norway and aiming to reach the coast of Northumberland at 40 miles an hour. They encounter a westerly wind of 20 m.p.h. and are drifted from their course along A-C and eventually reach the Norfolk coast at C^1.

35. The red triangle ABC, represents a flock leaving Denmark and aiming to reach the Suffolk coast at 40 miles an hour. They encounter a gale from the south at 40 miles an hour and are drifted from their course along A-C and eventually reach Caithness at C^1.

36. No wind is constant either in direction or speed, so these cases must be considered as diagrammatic only. But the general principle of migrational drift due to wind holds. Only in good visibility and absolute calm will migrating birds make landfall where they intend.

37. Birds do and will compensate for drift in fine weather when landmarks are visible; but without landmarks, they will face their intended direction and yet be subject to drift.

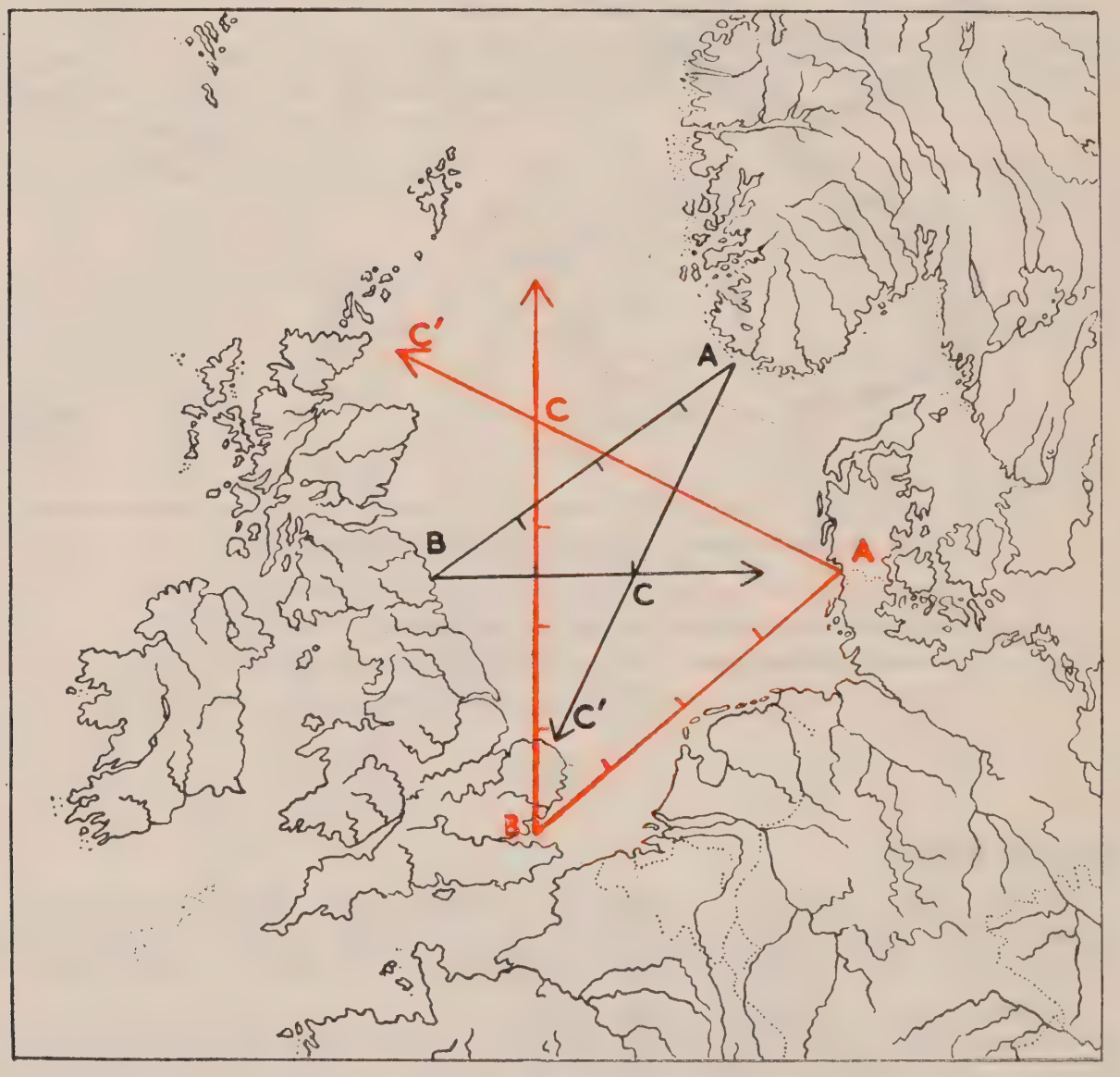

Fig. 3

Starling roosts

38. Small roosts of non-breeding birds occur during the breeding season and these are augmented by birds of the year so soon as they are fledged. These roosts, usually in shrubberies of holly, rhododendron, elder or laurels,

also occur in osier and reed beds, on cliffs and in buildings. In Inner London starlings commenced to roost on the island in the Serpentine in 1891 when about 200 birds congregated at night. This was abandoned about 1897 when about fifty birds used to collect on the National Gallery in Trafalgar Square. This roost has now spread in all directions to the Strand, St. Martin's Lane and Whitehall and their numbers are estimated at over 40,000 birds. Some of the continental roosts far exceed these numbers. One I visited in Sinai was among rocks and must have numbered almost a quarter of a million individuals. The largest roost in Britain is probably one recorded in Lancashire in March, 1945, when some 700,000 birds were estimated, and on some evenings probably exceeded the million mark.

39. When at roost, starlings sit just outside "pecking" distance but never nearer than three inches apart. There is never any contact.

40. Nearly all roosts in the British Islands are below 600 feet. Birds fly to roost from distances up to thirty miles, usually less, and once established in a roost will not leave it for a nearer one. It often happens that a flock will fly over an established roost which is not their own in order to reach their own home some ten miles further away. Flight to roost is almost invariably straight; on reaching the roost some flocks will rocket straight in, others will undertake most complicated concertina aerial movements before finally diving into roost. In wet or stormy weather, birds go straight in to roost without aerial manoeuvre. On the arrival of continental birds, these join the roosts of home-bred birds, though occasional individuals, always home-bred birds, will prefer their own solitary sleeping place in the hole of a tree or building. In the Outer Hebrides the resident bird never roosts communally, but retains his croft or cliff as a sleeping place; whilst the immigrant prefers a communal roost on a hill-side or cliff or even on stacked wrack.

41. A large roost in Hampshire between 1894 and 1896 was formed in about a hundred acres of reed-bed. The ground was so fouled that neither reed-warbler nor water-rail nested in those reeds for two years, and evacuated seeds carpeted the ground with young elder bushes, ivy and cotoneaster. It is this roost which is referred to in connexion with suspected infection of cattle with foot-and-mouth disease.

42. On more than one occasion, when visiting starling roosts, I have found large numbers of dead birds lying under the bushes. Their open mouth with protruding tongue was characteristic.

The parasites of the Starling

43. *External.*—These comprise Mallophaga or feather-lice; they live on feathers and debris on the bird's skin; they do not normally suck blood. Birds are infected from their parents, their mates or by phoresy. These parasites live their entire existence on their host, laying their eggs on the host's feathers.

On the Starling are found:—

Sturnidoecus sturni (Schrank).

Bruelia nebulosa (Burmeister).

Bruelia sp. (not yet described).

Myrsidea cucullaris (Nitzsch).

Menacanthus mutabilis (Blagoveshtchensky).

44. Sheep ticks (*Ixodes*) are often found adhering to the head. These are picked up from the ground when feeding and when gorged, leave the host.

45. Mites (*Acarina*) frequently occur in large numbers on Starlings.

46. Flat flies or louse-flies (*Hippoboscids*) occur on Starlings only from spring to autumn. They are blood suckers, breeding in the ground. As many as eleven Mallophaga have been found attached to one fly and these would be carried from one bird to another.

47. Fleas. The dominant flea on starlings is *Ceratophyllus gallinae* (Schrank); it has never been found on cattle but will bite man. Though, potentially, this flea can act as a vector of disease, there is no proof thereof.

48. Nothing is known about any connexion between these parasites and the virus of foot-and-mouth disease.

49. *Internal.* I am not competent to deal with this aspect.

A suggested experiment

50. Under Starling roosts I have mentioned a case in Hampshire (at Mottisfont on the River Test) when a large roost was established in about a hundred acres of reed-bed between 1894 and 1896. The surrounding land was pasture on which a herd of cattle grazed in winter, but they had access to the fringe of the reed-bed. In October several cattle sickened and were slaughtered on a Veterinary Surgeon's orders on the grounds of anthrax. The cattle were removed to another pasture when the whole herd sickened and the disease was then diagnosed as foot-and-mouth. I recollect well the farmer interviewing my father with a view to burning the reed-bed as he suspected the starlings. This was tried, but proved to be impossible owing to the wet winter. This experience suggests the following experiment.

51. That a small herd of cattle be consistently fed and grazed under a large starling roost; proper controls being kept immune. If these exposed cattle contracted foot-and-mouth within a reasonable time, I believe the starling suspect is capable of positive proof as a vector of virus under ordinary conditions of stock husbandry.

52. I also suggest that East Coast farmers be asked to co-operate in reporting flocks of migrant starlings on their land and that these occurrences be co-ordinated with the meteorological maps which can be obtained daily from the Meteorological Office; these maps would give a fairly accurate idea of the point whence these flocks left the Continent, using the "triangle of velocities".

53. This experiment should be repeated, especially when epidemics occur on the east coast of the North Sea.

Epilogue

54. If the starling is convicted without a shadow of doubt, what can you do about it? Beyond the satisfaction of conviction, no sentence can be pronounced. To destroy the species would be impossible and to reduce their numbers, a doubtful expedient, would require co-operation throughout Europe and well beyond the Iron Curtain.

55. Immunisation through inoculation is the obvious answer.

THE CONTROL OF IMPORTS OF LIVESTOCK INTO GREAT BRITAIN

Memorandum by the Ministry of Agriculture and Fisheries

1. Strict control over the importation of livestock into Great Britain has been exercised for many years under the Diseases of Animals legislation. Broadly, the importation is prohibited of live cattle, sheep, other ruminating animals and pigs. From most countries the prohibition is complete; from others, animals may be imported provided they are slaughtered at the port of landing. There is special provision for the importation of cattle from Canada, and livestock in general from Ireland. Pedigree livestock may be imported from some Commonwealth territories. The legislation also provides for the importation under special Order of the Ministry of Agriculture of animals intended for exhibition or for other exceptional purposes. This power has always been exercised very sparingly.

2. The purpose of this control is to prevent the importation of animal diseases such as foot-and-mouth disease, rinderpest and vesicular exanthema. It is accepted without question by veterinary experts in all countries that diseases of animals, particularly those caused by viruses, are most readily spread by the movement of live animals, and it is for this reason that Great Britain and many other countries maintain such stringent regulations regarding the importation of those types of live animals that are potential carriers of disease.

February, 1953.

DISEASES OF ANIMALS (BOILING OF ANIMAL FOODSTUFFS) ORDER OF 1947

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(6850)

ORDER OF THE MINISTER OF AGRICULTURE AND FISHERIES

(Dated 2nd May, 1947)

DISEASES OF ANIMALS (BOILING OF ANIMAL FOODSTUFFS) ORDER OF 1947

The Minister of Agriculture and Fisheries, by virtue and in exercise of the powers vested in him under the Diseases of Animals Acts, 1894 to 1937, and of every other power enabling him in this behalf, hereby orders as follows:—

Precautions to be adopted in regard to certain Animal Foodstuffs

1.—(1) Subject as herein provided, every person having in his possession or under his charge—

(*a*) any meat, bones, offal or other part of the carcase of an animal ; or

(*b*) any part of the carcase of any poultry ; or

(*c*) any swill ; or

(*d*) any other broken or waste foodstuffs which have been in contact either with meat, bones, offal or other part of the carcase of an animal or with any part of the carcase of any poultry

shall cause such articles to be boiled before they are fed to animals or poultry, and until they are so boiled, shall keep the articles so that no animal or poultry shall have access thereto.

(2) If any animal or poultry comes into contact with any article mentioned in sub-paragraph (1) hereof, unless and until such article has been boiled, the owner of the animal or poultry and the person in charge thereof shall be deemed to have committed a breach of the provisions of this Order unless he proves to the satisfaction of the Court that he took all reasonable steps to prevent the animal or poultry as the case may be from coming into contact with any such article.

(3) The provisions of this Article shall not apply to swill obtained from premises in respect of which the occupier thereof holds an effective certificate from the Minister or the Local Authority certifying that all swill supplied therefrom is subjected on such premises to a process of boiling within the meaning of this Order.

Certification as to Boiling of Swill

2.—(1) A Local Authority may, in respect of any premises, except such as are owned or occupied by such Local Authority or by an officer or servant thereof, grant to the occupier thereof a certificate to the effect that all swill supplied therefrom is subjected thereon to a process of boiling within the meaning of this Order, if it is satisfied that adequate arrangements are in force to ensure that all swill removed from such premises is so boiled and that all reasonable precautions are taken thereon to prevent the contamination of the boiled swill by or with any of the articles mentioned in Article 1 of this Order which have not been so boiled.

(2) Certificates in respect of premises owned or occupied by Local Authorities or by officers or servants of such Local Authorities shall not be granted except by the Minister.

Exemption of Proprietary Foodstuffs

3.—(1) This Order shall not apply to any proprietary foodstuff in respect of which the manufacturer thereof holds an effective certificate of exemption from the provisions of this Order granted by the Minister.

(2) A certificate of exemption shall not be granted by the Minister in respect of any proprietary foodstuff unless he is satisfied that the process of manufacture or preparation of it includes the boiling of it.

Saving for Existing Certificates

4.—Certificates granted by the Minister under the Foot-and-Mouth Disease (Boiling of Animal Foodstuffs) Order of 1932, or by the Minister or by a Local Authority under the Foot-and-Mouth Disease (Boiling of Animal Foodstuffs) (Amendment) Order of 1940, and in operation at the commencement of this Order, shall have effect as if granted under this Order.

Revocation of Certificates granted by the Minister

5.—The Minister may revoke at any time any such certificate as aforesaid granted by him and such certificate shall thereupon cease to be effective.

Offences

6.—Any person committing or aiding, abetting, counselling or procuring the commission of any breach of the provisions of this Order, shall be liable, on conviction, to the penalties provided by the Diseases of Animals Acts, 1894 to 1937.

Interpretation

7.—In this Order the expression

" animals " means cattle, sheep, pigs or goats ;

" poultry " includes birds of the following species, that is to say, domestic fowls, turkeys, geese, ducks, guinea-fowls, domestic pigeons and pheasants kept in captivity ;

" boiled " means exposed for a period of at least one hour by any process to a temperature of not less than 212° F., and the expression " boiling " shall be construed accordingly ;

" swill " means any broken or waste foodstuffs, including table or kitchen refuse, scraps or waste, containing any meat, bones, offal or portions thereof, or any other part of the carcase of an animal, or any part of the carcase of any poultry ;

" bones " includes ground green or raw bones.

Local Authority to enforce Order

8.—The provisions of this Order shall be executed and enforced by the Local Authority.

Revocation of the Foot-and-Mouth Disease (Boiling of Animal Foodstuffs) Order of 1932 *and the Foot-and-Mouth Disease (Boiling of Animal Foodstuffs) (Amendment) Order of* 1940

9.—The Foot-and-Mouth Disease (Boiling of Animal Foodstuffs) Order of 1932 and the Foot-and-Mouth Disease (Boiling of Animal Foodstuffs) (Amendment) Order of 1940 are hereby revoked.

Commencement

10.—This Order shall come into operation forthwith.

Short Title

11.—This Order may be cited as the Diseases of Animals (Boiling of Animal Foodstuffs) Order of 1947.

IN WITNESS whereof the Official Seal of the Minister of Agriculture and Fisheries is hereunto affixed this second day of May, nineteen hundred and forty-seven.

(L.S.) *T. Williams,*
Minister of Agriculture and Fisheries.

STATUTORY INSTRUMENTS

1954 No. 853

ANIMALS

PRECAUTIONS AGAINST DISEASE

The Importation of Carcases and Animal Products Order, 1954

Made - - - - 23*rd June*, 1954
Coming into Operation 3*rd July*, 1954

The Minister of Agriculture and Fisheries, in exercise of the powers conferred upon him by Sections 1, 24, 33, 84 and 85 of the Diseases of Animals Act, 1950(**a**), and Section 11 of the Agriculture (Miscellaneous Provisions Act, 1954(**b**), and of all other powers enabling him in that behalf hereby makes the following Order:—

Citation and Commencement

1. This Order which may be cited as the Importation of Carcases and Animal Products Order, 1954, shall come into operation on the 3rd July, 1954.

Interpretation

2. The Interpretation Act, 1889(**c**), shall apply to the interpretation of this Order as it applies to the interpretation of an Act of Parliament.

Extension of definition of "Disease"

3. For the purposes of Sections 1, 24 and 33 and Part III of the Diseases of Animals Act, 1950, and this Order, the definition of the expression "disease" contained in paragraph (*a*) of sub-section (3) of Section 84 of the Diseases of Animals Act, 1950 is hereby extended to include the following diseases:—

East African swine fever, teschen disease, and vesicular exanthema.

Carcases and Animal Products to which this Order applies

4. This Order shall apply to the following carcases and animal products:—

the carcase or any part or portion of a carcase of any swine, or of any bovine animal sheep goat or any other ruminating animal, including any cooked, uncooked or processed meat or meal offal derived in whole or in part from any of the before-mentioned animals, any blood, dried blood, blood meal, bones, bone flour, bone meal, hair, hooves, hoof meal, horns, horn meal or any other part or product of such animal, whether separate or mixed with some other product, except any of the parts and products set out in the First Schedule to this Order.

Prohibition of Importation of Carcases and Animal Products into Great Britain

5.—(1) Subject to the provisions of this Order, no person shall land in Great Britain any carcase or animal product to which this Order applies except in accordance with the conditions of a licence granted by the Minister of Agriculture and Fisheries—provided that nothing in this Order shall be deemed to prohibit or restrict the landing without a licence of—

(*a*) any carcase or animal product to which this Order applies from any country included in Part I of the Second Schedule to this Order, or

(*b*) any such animal product as is mentioned in Part II of the Second Schedule to this Order from any country therein specified in relation to that product.

(2) The Minister of Agriculture and Fisheries may attach to any licence issued under the powers conferred by this Article, any conditions he may think fit for the purpose of preventing the introduction or spread of disease.

(**a**) 14 Geo. 6. c. 36. (**b**) 2 and 3 Eliz. 2. c. 39. (**c**) 52 and 53 Vict. c. 63.

Animal Products to be admitted conditionally from certain countries

6. Notwithstanding the provisions of the foregoing Article of this Order, no licence shall be required for the landing in Great Britain of any carcase or animal product referred to in the first column of the Third Schedule to this Order originating in any country or part of a country set out opposite to that product in the second column thereof, if the requirements relating to that product in respect of that country or that part of a country as set out in the third column of the aforesaid Schedule are fulfilled.

7. Certificates and declarations required under this Order shall be delivered to the proper Officers of Customs and Excise by the person in charge of any carcase or animal product on the landing thereof.

Power to require re-exportation of carcases or parts of carcases landed in contravention of this Order

8. Any Officer of the Ministry of Agriculture and Fisheries may serve a Notice on the owner or person in charge of any thing which may have been landed in contravention of this Order, requiring the exportation of such thing.

Transitional Provisions

9. Until 15th September, 1954 any licence granted under any Order revoked by Article 10 of this Order, and in force immediately before the coming into operation of this Order, shall have effect as if granted under this Order.

Revocation

10. The Orders specified in the Fourth Schedule to this Order are hereby revoked.

In witness whereof the Official Seal of the Minister of Agriculture and Fisheries is hereunto affixed this 23rd day of June, nineteen hundred and fifty-four.

(L.S.) *Tom Dugdale,*
Minister of Agriculture and Fisheries.

FIRST SCHEDULE

Products to which the order does not apply (admitted unconditionally from all countries)

Bone-and-meat meal
Bone charcoal
Corned meat
Hides and skins which have been dried or dry-salted
Lard and rendered fats
Leather
Meat (including canned meat) which has been subjected to a process of cooking throughout its whole substance so as to render it unnecessary for it to be further cooked before being used for human consumption
Meat meal
Pigs' bristles (dressed, bunched and sorted)
Steamed bone flour
Superphosphates
Wool grease fatty acids

SECOND SCHEDULE

PART I

Countries from which importation of carcases and animal products is permitted unconditionally

Australia	Isle of Man
Canada	New Zealand
Channel Islands	Northern Ireland
Falkland Islands	Norway
Finland	Republic of Ireland
Iceland	Union of South Africa

PART II

Countries from which importation of certain animal products is permitted unconditionally

Country	*Product*
Any country which is not included in Part I of this Schedule and is outside the Continent of Europe.	Bones, bone flour, bone meal, hooves, hoof meal, horns, horn meal. Hides or skins which have been wet-salted.

THIRD SCHEDULE

Carcases and animal products to be admitted conditionally from certain countries

Product	*Country*	*Requirement*
Any carcase or any animal product to which this Order applies.	Southern Rhodesia (excluding the native districts of Nuanetsi, Chibi, Victoria, Gutu, Ndanga, Bikita, Buhera, Chipinga and Melsetter).	Each consignment to be accompanied by a certificate signed by a duly authorised Officer of the Government of Southern Rhodesia that the product originated in the part of Southern Rhodesia specified in the second column of this Schedule.
Dry sausage (salami).	Belgium, Cyprus, Denmark, France, Holland, Italy, Luxembourg, Portugal, Spain, Sweden, Switzerland, Western Germany.	Each consignment to be accompanied by a declaration naming the country of origin and stating that the consignment contains no meat or other animal product imported from any other country.
Fell-mongered goat hair and fell-mongered cow hair.	Any country not included in Part I of the Second Schedule to this Order.	Each consignment to be accompanied by a declaration (endorsed by an Officer duly authorised by the Government of the country of origin) stating that the hair has been pulled from hides and skins which have been treated with the lime process or by the chemical process.
Fresh or refrigerated meat (including edible offal).	Colombia, Denmark, Holland, Sweden, Switzerland.	Each consignment to be accompanied by a certificate signed by a duly authorised Officer of the Government of the country of origin certifying that the undermentioned safeguards have been observed. *Safeguards* 1. Animals for slaughter for export shall be slaughtered only at abattoirs approved for the purpose by the Government of the country of origin. Such abattoirs shall not be used for the purpose of slaughtering for export to Great Britain if situated within 20 kilometres of a farm or premises infected with foot-and-mouth disease unless separated from such farm or premises by the sea or by tidal salt waters. 2. Animals for slaughter for export to Great Britain shall be slaughtered exclusively on certain days on which all animals (including sheep and pigs) in the slaughterhouse will have complied with the conditions of paragraphs 3 and 4. 3. All animals shall be inspected before and after slaughter by veterinary surgeons approved by the Government of the country of origin, and shall be certified as being free from foot-and-mouth disease.

Product	*Country*	*Requirement*
Fresh or refrigerated meat (including edible offal)—*contd.*	Columbia, Denmark, Holland, Sweden, Switzerland—*contd.*	4. No animals to be slaughtered for export to Great Britain shall be drawn from a farm or premises situated within 20 kilometres of a farm or premises infected with foot-and-mouth disease unless separated from such farm or premises by the sea or by tidal salt waters. 5. If foot-and-mouth disease is found in an abattoir approved for the slaughter of animals for export to Great Britain, the effected animal and those which have been in contact with it, shall be disposed of otherwise than by export to Great Britain, and the premises shall be thoroughly disinfected before slaughtering for export to Great Britain is resumed. 6. Meat for export to Great Britain shall be moved direct to a port for immediate shipment or stored in accommodation specially set aside and used exclusively for such meat.
Fully cured bacon and ham.	Belgium, Cyprus, Denmark, France, Holland, Italy, Luxembourg, Portugal, Spain, Sweden, Switzerland, Western Germany, Poland excluding the area within sixty kilometres of the Czechoslovakian frontier.	Each consignment to be accompanied by a certificate signed by a duly authorised Officer of the Government of the country in which the bacon or ham has been cured describing fully the process of curing to which it has been subjected which shall be one of the following:— (i) pumping with brine under a pressure of 80 lbs. or more to the square inch and subsequently soaking in brine or dry-salting for a period of not less than four days, or (ii) salting (wet-salting or dry-salting) for a period of not less than ten days: Provided that— (*a*) In the case of bacon and ham cured or brought from Denmark, Holland, Sweden and Poland the above-mentioned certificate will not be required if every side or piece of such bacon or ham is stamped or branded with an official stamp or brand of a pattern prescribed by the regulations of the Government of the country and recognised by the Minister of Agriculture and Fisheries. (*b*) Each consignment from Poland shall in any case be accompanied by a certificate signed by a duly authorised Officer of the Government of the country that the product originated in the part of Poland specified in the second column of this Schedule.
Hides and skins which have been wet-salted.	Any European country or part of a country except any country included in Part I of the Second Schedule.	Each consignment to be accompanied by a certificate signed by a duly authorised Officer of the Government of the country in which the port of shipment is situated to the effect that he is satisfied that the hides or skins have been wet-salted for a period of fourteen days.

Product	*Country*	*Requirement*
Meat, including edible offal.	Argentina, Brazil, Chile, Uruguay.	Each consignment to be derived from frigorificos recognised by the Minister of Agriculture and Fisheries for the purpose of the Order.
Meat, including edible offal (other than pig meat).	United States of America.	Each consignment to be accompanied by a certificate signed by a duly authorised Officer of the Federal Government certifying that the meat is not pig meat and is derived from abattoirs which are subject to Federal meat inspection.
Pig meat.	Kenya (excluding the Coast Province, the Northern Province, the North Nyeri administrative district of the Central Province and the African areas of the Nyanza, Rift Valley, Central and Southern Provinces).	Each consignment to be accompanied by a certificate signed by a duly authorised Officer of the Government of Kenya that the product originated in the part of Kenya specified in the second column of this Schedule and was prepared, processed or packed in a plant approved by the Government of Kenya.
Sausage casings. (cleaned and scraped).	Belgium, Cyprus, Denmark, France, Holland, Italy, Luxembourg, Portugal, Spain, Sweden, Switzerland, Western Germany.	Each consignment to be accompanied by a declaration naming the country of origin and stating that the consignment contains no sausage casings imported from any other country.

FOURTH SCHEDULE

(Article 10)

Orders Revoked

The Importation (Raw Tongues) Order of 1913 (**d**)

The Importation (Raw Tongues) Amendment Order of 1913 (**e**)

The Importation of Carcases (Prohibition) Order of 1926 (**f**)

The Importation of Carcases (Prohibition) (Amendment) Order of 1926 (No. 2) (**g**)

The Importation of Carcases (Prohibition) (Amendment) Order of 1926 (No. 3) (**h**)

The Importation of Carcases (Prohibition) (Amendment) Order of 1926 (No. 4) (**i**)

The Importation of Carcases (Prohibition) (Amendment) Order of 1927 (**j**)

The Importation of Carcases (Prohibition) (Amendment) Order of 1928 (**k**)

EXPLANATORY NOTE

(*This Note is not part of the Order but is intended to indicate its general purport.*)

This Order which is made under the Diseases of Animals Act, 1950, regulates the import into Great Britain of meat and animal products which may introduce animal diseases. The principal provision of the Order is that no person may land in Great Britain any carcases or animal products to which it applies except in accordance with a licence granted by the Minister of Agriculture and Fisheries. The Order, in its Schedules, also sets out (1) animal products to which the Order does not apply and which may, therefore, be imported unlicensed from all countries, (2) certain countries from which products to which the Order applies may be imported unlicensed, and (3) products which may be imported from specified countries, if certain safeguards are satisfied.

(**d**) S.R. & O. 1913/44 (Rev. II, p. 412).
(**e**) S.R. & O. 1913/1153 (Rev. II, p. 412).
(**f**) S.R. & O. 1926/574 (Rev. II, p. 393: 1926 p. 76).
(**g**) S.R. & O. 1926/729 (Rev. II p. 395: 1926 p. 78).
(**h**) S.R. & O. 1926/834 (Rev. II, p. 393: 1926 p. 80).
(**i**) S.R. & O. 1926/1043 (Rev. II, p. 396: 1926 p. 83).
(**j**) S.R. & O. 1927/112 (Rev. II, p. 393: 1927 p. 55).
(**k**) S.R. & O. 1928/7 (Rev. II, p. 398: 1928 p. 169).

CONTROL MEASURES IN GREAT BRITAIN

Memorandum by the Ministry of Agriculture and Fisheries

1. The Acts relating to diseases of animals were consolidated in 1950 into a single Act, the Diseases of Animals Act, 1950. The Act gives the Minister wide powers to control animal diseases and to make Orders for a number of specific purposes. In connexion with foot-and-mouth disease, Orders have been made providing for:—

(*a*) the declaration of a place as an Infected Place (e.g. farm premises on which an outbreak has occurred) and of an area as an Infected Area (i.e. normally an area within a 15 mile radius of the Infected Place);

(*b*) the declaration of a Controlled Area (i.e. any area of any extent in which it is considered necessary to restrict the movement, etc. of animals);

(*c*) the procedure to be followed in an Infected Place, an Infected Area, and a Controlled Area;

(*d*) the regulation of the movement of animals; and

(*e*) the prohibition of the importation of animals, carcases, fodder, litter, dung, etc.

2. The Act empowers the Minister to cause to be slaughtered any animals affected with foot-and-mouth disease, any animals suspected of being so affected, and any animals which appear to have been exposed to infection; and to pay compensation. It also provides that the local authorities and the police shall execute and enforce the Act and the Orders of the Minister.

3. The Orders that have been made fall generally into three categories:—

(*a*) those designed to prevent the spread of the disease when outbreaks occur;

(*b*) those of a general preventive nature; and

(*c*) those which have for their object the minimising of the risk of the introduction of the disease from abroad.

The three main Orders under (*a*) are:—

(i) The Foot-and-Mouth Disease Order of 1928, and the amending Orders of 1930 and 1938.

These Orders provide for the immediate notification to the police of the existence of the disease (or suspected disease); for the declaration of premises as an Infected Place (and the rules to be observed thereon); disinfection; prohibition of movement of animals affected with the disease, suspected of being affected or exposed to infection; and for the prohibition of the movement of any person, animal, or thing, on to or from any place that may be attended with a risk of the spread of the disease.

(ii) The Foot-and-Mouth Disease (Infected Areas Restrictions) Order of 1938.

This Order provides for the imposition of restrictions on the movement of animals in, into or out of an Infected Area, the issue of movement licences, the restrictions on markets, and the general precautionary measures in an Infected Area (i.e. the disposal of slaughterhouse manure and refuse, the straying of animals, the control of dogs and poultry, the closing of footpaths and premises, the disinfection of vehicles used for the conveyance of animals, the prohibition of hunting, coursing, and whippet racing).

(iii) The Foot-and-Mouth Disease (Controlled Area Restrictions) General Order of 1938.

This Order provides for the imposition of restrictions on the movement of animals in, into or out of a Controlled Area, on the holding of markets, sales, and gatherings of animals, and prescribes the conditions of movement licences, and the rules for the disposal of slaughterhouse manure and refuse.

4. The Orders which are of a general preventive nature (*b*), and those which are designed to minimise the risk of the introduction of the disease from abroad (*c*), are as follows:—

(*b*) (i) The Diseases of Animals (Boiling of Animal Foodstuffs) Order of 1947.

This Order requires the boiling of all meat, bones, offal or other parts of the carcase of an animal, any part of the carcase of any poultry, and all swill or other broken or waste foodstuffs which have been in contact with meat, bones, offal or other part of the carcase of an animal or with any part of the carcase of any poultry, before being fed to animals or poultry or before animals or poultry are allowed to have access thereto. "Boiling" for the purposes of the Order means exposed for a period of at least one hour to a temperature of not less than 212° F.

(ii) The Foot-and-Mouth Disease (Disinfection of Road Vehicles) Order of 1941 and the amending Order of 1942.

These Orders require the disinfection with a 4 per cent. solution of sodium carbonate of all vehicles that have been used for the carriage of unboiled swill or for the carriage of any bag, sack or other container in which such material has been carried, before the vehicle is again used for the carriage of feeding-stuffs for animals or litter or anything intended to be used for or about animals.

(iii) The Foot-and-Mouth Disease (Packing Materials) Order of 1925 and the amending Order of 1926.

These Orders prohibit the bringing into contact with animals in Great Britain of:—

(*a*) any hay and straw that has been used for packing purposes;

(*b*) any cloth, wrapping, sacking or other material that has been used for or in connexion with the wrapping of meat, meat products, offals or any other part of the carcase of an animal (unless and until such material has been thoroughly sterilised after being so used); and

(*c*) any box, crate, basket or other receptacle that has been used for, or in connexion with, the carriage of meat and meat products (except cooked or preserved meat or meat essences).

(iv) The Foot-and-Mouth Disease (Sera and Glandular Products) Order of 1939.

This Order regulates the use of sera and glandular extracts by prohibiting the use, for the treatment of animals, of any such substances unless they are sold or supplied in a vessel, container, or package bearing the words "The use of this preparation for veterinary purposes is authorised under the Foot-and-Mouth Disease (Sera and Glandular Products) Order of 1939". Such labels may not be applied to containers except by a person authorised by the Ministry so to do. Such authorisation is given only in those cases in which the Ministry is satisfied either that the source of the product is free from the virus of disease or that the method of preparation would be lethal to the virus.

(v) The Markets, Sales and Lairs Order of 1925, and the amending Orders of 1926 and 1927.

The purpose of these Orders is to ensure that market premises used regularly for the sale of animals, and lairs used in connexion with such markets, are properly cleansed and disinfected.

(vi) The Transit of Animals Order of 1927, and the amending Orders of 1927, 1931, 1939 and 1947.

Under these Orders it is obligatory to cleanse and disinfect on prescribed occasions, and in the prescribed manner, all vessels used for the carriage of animals by sea, river, canal, etc., all railway trucks and vehicles used for the carriage of animals by rail and all motor and horse-drawn vehicles used for the carriage of animals by road.

(vii) The Movement of Animals (Records) Order of 1925.

Under this Order stockowners are required to keep records of the movements of animals to and from their premises. (These records are of the greatest use in facilitating the tracing of the movements of animals.)

(*c*) (i) The Animals (Importation) Order of 1930, and the amending Orders of 1931, 1933 and 1937.

These Orders prohibit the importation of animals, carcases, etc. from prohibited countries.

(ii) The Foreign Hay and Straw Order of 1912, and the amending Orders of 1912, 1913, 1939 and 1947.

These Orders prohibit the landing in Great Britain of hay and straw brought from any country outside the United Kingdom, except in the case of certain specified countries. The specified countries are those that, for the time being, are free from foot-and-mouth disease. (The Orders do not apply to hay and straw which at the time of importation is being used for packing merchandise; manufactured straw; hay and straw accompanying animals landed at an Imported Animals Wharf; or hay and straw which is authorised to be landed for use otherwise than as fodder or litter for animals by a licence granted by the Ministry.)

(iii) The Importation of Meat etc. (Wrapping Materials) Order of 1932, and the amending Order of 1939.

These Orders prohibit the landing in Great Britain from certain countries of meat or offals if they are packed or wrapped in cloths, bags, sacking or like material other than of the types prescribed, and also of feeding-stuffs, fertilisers or horticultural produce packed in bags or sacks made from jute, hemp, flax or other cloth of the prescribed types. Other provisions are included in these Orders for the purpose of ensuring that materials of the kind used as wrappers for meat from the prohibited countries are not also used as wrappers for commodities likely to be brought into contact with animals.

(iv) The Importation of Carcases and Animal Products Order, 1954.

This Order regulates the import into Great Britain of meat and animal products which may introduce animal diseases. The principal provision of the Order is that no person may land in Great Britain any carcases or animal products to which it applies except in accordance with a licence granted by the Minister of Agriculture and Fisheries. (See Appendix XI.)

(v) The Animals (Landing from Ireland, Channel Islands and Isle of Man) Order of 1933, and the amending Order of 1933.

(vi) The Importation of Canadian Cattle Order of 1933, and the amending Orders of 1938 and 1939.

These Orders, *inter alia,* prohibit the movement of imported animals from one market to another during the first six days after their movement from the port of landing in Great Britain. (The inclusion of these provisions in the above named Orders had the effect of putting an end to the practice—which was then common only in the case of imported animals—of the hawking of animals by dealers from market to market in search of buyers. It was in consequence of this practice that a serious spread of disease occurred in Great Britain in 1922, animals having become infected shortly after landing in this country and while being hawked round various markets.)

THE CONTROL MEASURES IN CERTAIN EUROPEAN COUNTRIES, ARGENTINA, U.S.A. AND CANADA

1. (*a*) Stamping-out—Canada, Norway and the U.S.A.

(*b*) Stamping-out plus vaccination—Denmark, Finland, Holland, Sweden and Switzerland.

(*c*) Vaccination—Argentina, Belgium, France and the German Federal Republic.

(*d*) Isolation—the Union of Soviet Socialist Republics.

STAMPING-OUT

Canada

2. (*a*) Precautionary measures:—

(i) It is obligatory to report any suspicion of the disease to an officer of the Federal Veterinary Service. A nation-wide observer-reporter service exists.

(ii) Strict regulation of imports of livestock, livestock products and raw products of the soil which might carry infection. Such importations are prohibited from countries where the disease is known or suspected to exist.

(iii) The clothing and personal effects of immigrants are disinfected. Their baggage is searched for prohibited meat and meat products.

(*b*) Measures when outbreaks occur*:—

(i) All animals that are infected, suspected of being infected, or have been exposed or suspected of having been exposed to infection are slaughtered and buried. Full value is paid to owners; no salvage is undertaken.

(ii) The infected farm is isolated under police guard and disinfected. Any other farms to which infection is suspected of having been taken are also disinfected. Restocking takes place about three months after disinfection.

(iii) The surrounding neighbourhood—to a radius of about 15 miles—is closely quarantined. Movement of livestock in the quarantine area is prohibited and restrictions are imposed on the movements of human beings.

(iv) In a "buffer zone"—about 20 miles in radius—modified quarantine measures are imposed. Movements of livestock have to be licensed; the exit from and entry into the buffer zone of animals and animal products are prohibited; all vehicles leaving the zone have to be disinfected. Mounted police patrol the buffer zone.

(v) Farms in and near the zones are repeatedly inspected by Federal veterinarians, and all the stock moved previously to an outbreak are traced and inspected.

(In the 1952 outbreak, movement of livestock within or out of the whole of the provinces of Manitoba and Saskatchewan was prohibited, except for immediate slaughter. Infected abattoirs and meat packing stations were disinfected and closed for two months.)

Norway

3. (*a*) Precautionary measures:—

(i) Stockowners must report any suspicion of the disease to their veterinary surgeons.

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* This description is based on the action taken in 1952 when Canada experienced its first outbreak of foot-and-mouth disease.

(ii) The importation of living animals and infection carrying matter (meat and certain foodstuffs, etc.) is prohibited generally. Visitors from abroad, and their baggage, must be disinfected if they intend to visit a Norwegian farm within three months of landing.

(iii) When the disease situation becomes threatening in neighbouring countries, special measures are taken in south-eastern Norway (i.e. that part of the country that is specially exposed to infection). Movement and gatherings of animals are controlled; vehicles that carry animals or milk must be disinfected between loads and sale-yards are closed.

(*b*) Measures when outbreaks occur:—

(i) All animals in the infected herd are slaughtered and buried; the farm is disinfected. Market value is paid for animals slaughtered; no salvage is undertaken. Police guard the infected farm to ensure isolation. Occupants of the infected farm are not allowed to leave it, except for essential purposes, and they are then required to undergo disinfection.

(ii) All farms supplying the dairy which serves the infected farm are placed under restrictions. The area involved in these restrictions may be as much as 12-19 miles in radius. No animals or animal products may leave the area, and persons doing so are disinfected. The restrictions are lifted when the last farm in the area is free from the disease.

The U.S.A.

4. (*a*) Precautionary measures:—

(i) Any suspicion of foot-and-mouth disease must be reported to an official veterinarian, who calls in a trained diagnostician.

(ii) Animals, animal products, hay, fodder, etc., are imported only from countries that are free from the disease.

(*b*) Measures when outbreaks occur:—

(i) All affected and contact animals are slaughtered and buried, full market value being paid; no salvage is undertaken. The infected farm is isolated and disinfected.

(ii) Susceptible animals in the threatened neighbouring area are quarantined under close supervision.

STAMPING-OUT PLUS VACCINATION

Denmark

5. (*a*) Precautionary measures:—

(i) The reporting of suspected foot-and-mouth disease is compulsory.

(ii) Imports of animals and animal products from Germany are prohibited because the disease is thought to come to Denmark from that country.

(iii) Creamery and market authorities have power to compel farmers in their areas to vaccinate.

(*b*) Measures when outbreaks occur:—

(i) The infected farm is isolated and disinfected; no cloven-hoofed animal, alive or dead, may leave, and no milk, other animal products, hay, straw or fodder may be removed. Dogs and poultry must be confined, and human beings may leave only if on essential business and after they have washed and changed their clothes.

(ii) The movements of animals and people on farms within a radius of 250 yards of the infected premises are also controlled.

(iii) The movement of animals out of the "observation district" (which covers an area around the infected premises of just over a mile in radius) is prohibited except for immediate slaughter, for which a veterinary certificate of health is required.

(iv) In an area of 9 miles radius around the infected premises, markets, sales and shows are prohibited.

(v) Vaccination is compulsory for herds that have been in contact with infected animals, herds in " observation districts " and herds that provide milk for creameries that are supplied by farms in " observation districts ".

Finland

6. (*a*) Precautionary measures:—

The importation of live animals is prohibited, except under licence; imports of animal products are controlled and precautions are taken in connexion with imported agricultural products.

(*b*) Measures when outbreaks occur:—

(i) Stockowners whose animals become infected are legally bound to notify the authorities.

(ii) Generally all animals in infected herds are slaughtered and buried. Full value is paid. Salvage is occasionally carried out. The meat is kept on the farm for two days and treated with citric acid. It is then taken in special lorries to a special storehouse. The hides are treated with salt and soda for two weeks.

(iii) The infected farm is isolated and disinfected.

(iv) In the vicinity of the outbreak, gatherings of people, movements of animals, markets and shows are prohibited or restricted.

(v) In 1952-53, partial Ring vaccination of healthy animals was carried out when isolated outbreaks occurred, and the infected herds were slaughtered. When one area became heavily infected, all the infected animals in it were slaughtered and all the others vaccinated.

Holland

7. (*a*) Precautionary measures:—

(i) Suspected foot-and-mouth disease must be reported to the local Burgomaster who informs the Provincial Inspector of the Veterinary Service.

(ii) The importation of livestock is prohibited except under licence. Imports of animal products are prohibited.

(iii) " Measures are being taken to vaccinate the entire cattle population ".

(*b*) Measures when outbreaks occur:—

(i) All infected animals on the infected farm are slaughtered, and so are the unvaccinated beasts and those whose last vaccination was more than eight months before the outbreak. Slaughtering takes place at abattoirs, subject to special precautions; carcases are hung for 24 hours before being distributed for human consumption. Compensation for animals slaughtered is 75 per cent. of market value.

(ii) The infected farm is disinfected and isolated for 14 days, and during this period no movement of livestock or livestock products onto or off it is allowed.

(iii) Vaccination on farms adjoining the infected farm may be ordered.

Sweden

8. (*a*) Precautionary measures:—

(i) Stockowners must notify a veterinarian if they suspect foot-and-mouth disease in their animals.

(ii) Imports of live animals are kept to a minimum. Imported live animals are kept in quarantine on arrival. There are special regulations governing the importation of animal and other products that are potentially dangerous. Foreign farm workers and cattle trucks crossing the Sound from Denmark are disinfected.

(iii) When the spread of infection from Denmark is threatened, bulls at Artificial Insemination Centres, valuable breeding stock and large herds are vaccinated. In the areas particularly exposed to infection from Denmark, all livestock are vaccinated.

(*b*) Measures when outbreaks occur:—

(i) When the disease breaks out in a herd, the infected animals are slaughtered and buried on the farm. The others are taken to an abattoir for slaughter under special conditions. The carcases are distributed for human consumption after hanging for 48 hours. Specially valuable herds may be exempted from slaughter and isolated. Farmers are compensated in full for all animals slaughtered.

(ii) Infected farms are disinfected and isolated for twenty days.

(iii) Vaccination is carried out in an area at least 1 mile in radius around the infected farm, and a "standstill" order is imposed for twenty days. Artificial insemination is suspended until vaccination has had time to take effect.

(iv) If several outbreaks occur in a county, fairs, auctions etc. are prohibited.

Switzerland

9. (*a*) Precautionary measures:—

(i) The reporting of suspected foot-and-mouth disease is compulsory.

(ii) Importations of animals are specially supervised. The importation of animal feeding-stuffs from infected countries is prohibited. When outbreaks occur near the border in adjacent countries, the movement of persons and goods across that part of the frontier is prohibited.

(iii) "Frontier" vaccination is carried out along those parts of the frontier that are particularly exposed to infection from the adjacent countries.

(*b*) Measures when outbreaks occur:—

(i) All susceptible animals on an infected farm are slaughtered. They are taken to abattoirs in specially sealed lorries. The carcases are hung for 48 hours and distributed to urban areas for human consumption. The farmer is paid 80 per cent. of the market value of his animals.

(ii) The infected farm is completely isolated for 15 days and put under police guard. Thorough disinfection is carried out by trained squads equipped with power-sprays and flame-throwers.

(iii) Animals on other farms in the neighbourhood are vaccinated and they may not leave those farms for 15 days. The area in which this vaccination is carried out varies from a $\frac{1}{4}$ mile to 6 miles in radius.

Vaccination

Argentina

10. (*a*) Precautionary measures:—

(i) Imported animals must pass through a quarantine station.

(ii) Farmers are encouraged to vaccinate their animals.

(*b*) Measures when outbreaks occur:—

(i) The reporting of suspected foot-and-mouth disease is obligatory.

(ii) Infected farms are temporarily closed, and vaccine and serum are used to stop the disease spreading.

(iii) Only in Patagonia, which is usually free from the disease, are infected animals slaughtered.

Belgium

11. (*a*) Precautionary measures:—

(i) The reporting of suspected foot-and-mouth disease is compulsory.

(ii) The importation of animals and animal products is controlled.

(iii) Animals in frontier areas are vaccinated, and general vaccination is encouraged.

(*b*) Measures when outbreaks occur:—

(i) The infected farm is put in quarantine and the infected animals are isolated from the rest. All animals, including dogs and poultry, are confined. Disinfection by trained squads is carried out.

(ii) Vaccination is carried out in a protective zone of $\frac{1}{4}$ to $\frac{1}{2}$ mile in radius. No animals may leave the zone for 15 days. If there is a threat of the disease spreading, fairs and markets, etc., may be prohibited in the threatened area.

France

12. (*a*) Precautionary measures:—

(i) Stockowners are required to report any suspicion of the disease to the authorities.

(ii) Vaccination is regularly carried out along the Spanish and Swiss frontiers.

(iii) The Government encourage farmers to vaccinate.

(*b*) Measures when outbreaks occur:—

(i) The infected farm is isolated and all animals, including cats and dogs, are quarantined. Sick animals are treated, and disinfection is carried out. The restrictions, which prohibit movements of animals away from the farm except for immediate slaughter, are withdrawn 15 days after the affected animals have recovered. Similar restrictions may also be placed on adjoining farms.

(ii) Animals along the perimeter of an area averaging 6 miles in radius around the infected farm are vaccinated. The holding of fairs and markets in the locality is prohibited or controlled.

The German Federal Republic

13. (*a*) Precautionary measures:—

The importation of animals and animal products is controlled. Veterinary inspection and disinfection take place at the frontiers.

(*b*) Measures when outbreaks occur:—

(i) Stockowners must report outbreaks to the police.

(ii) Infected farms are disinfected and isolated for four weeks.

(iii) In primary outbreaks, infected animals on the farm are slaughtered and the remainder vaccinated. In other outbreaks affected animals are isolated and the other animals on the farm are vaccinated. People who have been in contact with the disease must be disinfected.

(iv) Vaccination is compulsory on all farms suspected of having had contact with the infected farm.

(v) No susceptible animals may be moved into or out of an area around the infected farm until the premises have been released from restrictions.

ISOLATION

The Union of Soviet Socialist Republics

14. In the U.S.S.R. foot-and-mouth disease is notifiable and is dealt with by isolation of affected herds and quarantine of affected districts, accompanied by the usual measures of disinfection and control of movement of animals and materials which may carry infection. Convalescent serum is occasionally used for prophylactic purposes. When the disease occurs in a mild form, it may be spread amongst in-contact animals by inoculation with natural virus to hasten the end of an outbreak.

CONSTITUTION OF THE EUROPEAN COMMISSION FOR THE CONTROL OF FOOT-AND-MOUTH DISEASE

PREAMBLE

The contracting Governments, having regard to the urgent necessity of preventing the recurrence of the heavy losses to European agriculture caused by the repeated outbreaks of foot-and-mouth disease, hereby establish a Commission to be known as the European Commission for the Control of Foot-and-Mouth Disease, whose object shall be to promote national and international action with respect to control measures against foot-and-mouth disease in Europe.

ARTICLE I

Membership

The Members of the European Commission for the Control of Foot-and-Mouth Disease (hereinafter referred to as the "Commission") shall be such European Member Nations of the Food and Agriculture Organization of the United Nations (hereinafter referred to as the "Organization") and/or of the International Office of Epizootics (hereinafter referred to as the "Office") as accept this Constitution in accordance with the provisions of Article XV. The Commission, by a two-thirds majority of the votes cast providing such majority is greater than half of its membership, may, with the approval of the Council of the Organization, in conformity with the provisions of Article XV (3), admit to membership any other European Nation which has submitted an application for membership and a declaration made in a formal instrument that it accepts the obligations of this Constitution as in force at the time of admission.

The Organization, the Office and the Organization for European Economic Co-operation shall have the right to be represented at all sessions of the Commission and its Committees, but their representatives shall not have the right to vote.

ARTICLE II

Obligations of Members regarding National Policies and International Co-operation for the Control of Foot-and-Mouth Disease

1. Members undertake to control foot-and-mouth disease with a view to its ultimate eradication by the institution of suitable quarantine and sanitary measures and by one or more of the following methods:

(1) a slaughter policy

(2) slaughter together with vaccination

(3) maintenance of totally immune cattle population by vaccination

(4) vaccination in zones surrounding outbreaks.

Methods adopted shall be rigorously carried out.

2. Members adopting policy (2) or (4) undertake to have available a supply of virus for vaccine production and a supply of vaccine sufficient to ensure adequate protection against the disease in case of an outbreak. Each Member shall collaborate with and assist other Members in all concerted measures for the control of foot-and-mouth disease, and in particular in the provision of vaccine and virus where necessary. The quantities of virus and vaccine to be stored for national and international use shall be determined by Members in the light of the findings of the Commission and the advice of the Office.

3. Members shall make such arrangements for the typing of virus from outbreaks of foot-and-mouth disease as may be required by the Commission and shall immediately notify the Commission and the Office of the results of such typing.

4. Members undertake to provide the Commission with any information which it may need to carry out its functions. In particular, Members shall immediately report to the Commission and to the Office any outbreak of foot-and-mouth disease and its extent and shall make such further detailed reports as the Commission may require.

ARTICLE III

Seat

1. The seat of the Commission and its Secretariat shall be in Rome at the Headquarters of the Organization.

2. Sessions of the Commission shall be held at its seat, unless they are convened elsewhere in pursuance of a decision of the Commission at a previous session, or, in exceptional circumstances, of a decision of the Executive Committee.

ARTICLE IV

General Functions

The following shall be the general functions of the Commission:

1. To enter into arrangements, through the Director-General of the Organization, with the Office within the framework of any agreements between the Organization and the Office to ensure that:

1.1 All Members are provided with technical advice on any problem relating to the control of foot-and-mouth disease.

1.2 Comprehensive information on outbreaks of the disease and identification of virus is collected and disseminated as quickly as possible.

1.3 Special research work required on foot-and-mouth disease is carried out.

2. To collect information on national programs for the control of, and research on, foot-and-mouth disease.

3. To determine, in consultation with the Members concerned, the nature and extent of assistance needed by such Members for implementing their national programs.

4. To stimulate and plan joint action wherever required to overcome difficulties in the implementation of control programs and to this effect arrange means whereby adequate resources can be made available, for example, for the production and storage of vaccine, through agreements between Members.

5. To arrange for suitable facilities for the typing of virus.

6. To study the possibility of establishing international laboratory facilities to deal with the typing of virus and the production of vaccines.

7. To maintain a register of stocks of virus and vaccines available in various countries and to keep the position continuously under review.

8. To offer advice to other organizations on the allocation of any available funds for assisting in the control of foot-and-mouth disease in Europe.

9. To enter into arrangements, through the Director-General of the Organization, with other organizations, regional groups or with Nations not Members of the Commission, for participation in the work of the Commission or its Committees, or for mutual assistance on problems of controlling foot-and-mouth disease. These arrangements may include the establishment of, or participation in, joint committees.

10. To consider and approve the report of the Executive Committee on the activities of the Commission, the annual accounts and the budget and program for the ensuing year, for submission to the Council of the Organization through the Director-General.

ARTICLE V

Special Functions

The following shall be the special functions of the Commission:

1. To assist in controlling outbreaks in emergency situations in any manner considered appropriate by the Commission and the Member or Members concerned. For this purpose the Commission or its Executive Committee in conformity with the provisions of Article XI (5) may use any uncommitted balances of the Administrative Budget referred to in Article XIII (7) as well as any supplementary contributions which may be provided for emergency action under Article XIII (4).

2. To take suitable action in the following fields:
   2.1 Production and/or storage of virus and/or vaccines by or on behalf of the Commission, for distribution to any Member in case of need.
   2.2 Promotion when necessary of the establishment by a Member or Members of "cordons sanitaires" to prevent the spread of disease.

3. To carry out such further special projects as may be suggested by Members or by the Executive Committee and approved by the Commission for achieving the purposes of the Commission as set forth in this Constitution.

4. Funds from the surplus of the Administrative Budget may be used for the purposes stated in paragraphs 2 and 3 of this Article when such action is approved by the Commission by a two-thirds majority of the votes cast, providing such majority is more than one half of the membership of the Commission.

ARTICLE VI

Organization

1. Each Member shall be represented at Sessions of the Commission by a single delegate who may be accompanied by an alternate and by experts and advisers. Alternates, experts and advisers may take part in the proceedings of the Commission but not vote, except in the case of an alternate who is duly authorized to substitute for the delegate.

2. Each Member shall have one vote. Decisions of the Commission shall be taken by a majority of the votes cast except as otherwise provided in this Constitution. A majority of the Members of the Commission shall constitute a quorum.

3. The Commission shall elect, at the beginning of each regular session, a Chairman and two Vice-Chairmen from amongst the delegates. These Officers shall hold office until the beginning of the next regular session, without prejudice to the right of re-election.

4. The Director-General of the Organization in consultation with the Chairman of the Commission shall convene a regular session of the Commission at least once a year. Special sessions may be convened by the Director-General, in consultation with the Chairman of the Commission, or if so requested by the Commission in regular sessions or by at least one-third of the Members during intervals between regular sesssions.

ARTICLE VII

Committees

1. The Commission may establish temporary, special or standing committees to study and report on matters pertaining to the purpose of the Commission.

2. These Committees shall be convened by the Director-General of the Organization in consultation with the Chairman of the Commission, at such times and places as are in accordance with the objectives for which they were established.

3. The Commission shall determine the membership of such committees.

4. Each committee shall elect its own Chairman.

ARTICLE VIII

Rules and Regulations

Subject to the provisions of this Constitution, the Commission shall with the concurrence of the Director-General of the Organization, draw up its own Rules of Procedure and Financial Regulations in conformity with the Rules of Procedure and the Financial Regulations of the Organization.

ARTICLE IX

Observers

1. The Government of any Nation which is not a Member of the Commission may, with the concurrence of the Commission, be represented at any session of the Commission or its Committees by an observer without the right to vote.

2. Any other international organization having related interests may, with the concurrence of the Commission, be represented at any sessions of the Commission or its Committees by an observer without the right to vote.

ARTICLE X

The Executive Committee

1. An Executive Committee shall be established and shall be composed of the Chairman and Vice-Chairmen of the Commission and three delegates of Members selected by the Commission at the beginning of its regular session. The Chairman of the Commission shall be the Chairman of the Executive Committee.

2. Members of the Executive Committee shall hold office until the beginning of the next regular session without prejudice to the right of re-election.

3. If a vacancy occurs in the Executive Committee before the expiration of the term of appointment, the Committee may request a Member of the Commission to appoint a representative to fill the vacancy for the remainder of the term.

4. The Executive Committee shall meet at least once between any two successive regular sessions of the Commission.

5. The Secretary of the Commission shall act as Secretary to the Executive Committee.

ARTICLE XI

Functions of the Executive Committee

The Executive Committee shall:

1. Make proposals to the Commission concerning policy matters and the program of activities;

2. Implement the policies and programs approved by the Commission;

3. Submit to the Commission the draft program and Administrative Budget, and the annual accounts;

4. Prepare the annual report on the activities of the Commission for approval by the Commission and transmission to the Director-General of the Organization;

5. Undertake such other duties as the Commission may delegate to it, in particular with reference to emergency action under Article V (1).

ARTICLE XII

Administration

1. The staff of the Secretariat of the Commission shall be appointed by the Director-General with the approval of the Executive Committee, and for administrative purposes shall be responsible to the Director-General. They shall be appointed under the same terms and conditions as the staff of the Organization.

2. The expenses of the Commission shall be paid out of its administrative budget except those relating to such staff and facilities which can be made available by the Organization. The expenses to be borne by the Organization shall be determined and paid within the limits of an annual budget prepared by the Director-General and approved by the Conference of the Organization in accordance with the Rules of Procedure and the Financial Regulations of the Organization.

3. Expenses incurred by delegates and their alternates, experts and advisers in attending meetings of the Commission and its committees shall be determined and paid by their respective governments.

ARTICLE XIII

Finance

1. Each Member of the Commission undertakes to contribute annually its share of the administrative budget in accordance with a scale of contributions to be adopted by a two-thirds majority of the membership of the Commission. For the first five years after the Constitution has come into force, these contributions shall be in accordance with the scale indicated in Appendix I. The budget for the administrative activities of the Commission for the first five years shall be on the basis of US $50,000 annually, to which shall be added any contribution made by Members in conformity with paragraph 2 below.

2. Contributions to be paid by Members not listed in Appendix I shall be determined by the Commission. For this purpose the methods used for calculating the above-mentioned scale shall apply.

3. Annual contributions provided for under Paragraphs 1 and 2 above shall be payable before the end of the first month of the financial year to which they apply. The financial year shall be the same as that of the Organization.

4. Supplementary contributions may be accepted from a Member or Members or from Organizations or individuals for emergency action or for the purpose of implementing special schemes or campaigns of control which under Article V the Commission or Executive Committee may adopt or recommend.

5. All contributions from Members shall be payable in currencies to be determined by the Commission in agreement with each contributing Member.

6. All contributions received shall be placed in a Trust Fund administered by the Director-General of the Organization in conformity with the Financial Regulations of the Organization.

7. At the end of each financial year, any uncommitted balance of the Administrative Budget shall be placed in a special account to be available for the purposes outlined in Articles IV and V.

ARTICLE XIV

Amendments

1. This Constitution may be amended by the Commission by a two-thirds majority of the votes cast, providing such a majority is more than one-half of the membership of the Commission. Amendments shall become effective only with the concurrence of the Council of the Organization, and as from the date of the decision of the Council, provided that any amendment involving new obligations for Members shall come into force in respect of each Member only on acceptance of it by that Member.

2. Proposals for the amendment of the Constitution may be made by any Member of the Commission in a communication addressed to both the Chairman of the Commission and the Director-General of the Organization. The

Director-General shall immediately inform all Members of the Commission of all proposals for amendments.

3. No proposal for the amendment of the Constitution shall be included in the agenda of any session unless notice thereof has been received by the Director-General of the Organization at least 120 days before the opening of the session.

ARTICLE XV

Acceptance

1. Acceptance of this Constitution shall not be subject to any reservation.

2. Acceptance shall be effected by the deposit of a notification of acceptance with the Director-General of the Organization and shall take effect as regards Members of the Organization or the Office, on receipt of such notification by the Director-General who shall forthwith inform each of the Members of the Commission.

3. Membership of Nations that are neither members of the Organization nor of the Office shall become effective on the date on which the Council approves the application for membership in conformity with the provisions of Article I.

ARTICLE XVI

Withdrawal

1. Any Member may withdraw from the Commission at any time after the expiration of one year from the date on which its acceptance took effect or from the date on which the Constitution entered into force, whichever is the later, by giving written notice of withdrawal to the Director-General of the Organization who shall forthwith inform all Members of the Commission. The withdrawal shall become effective one year from the date of receipt of the notification of withdrawal.

2. Non-payment of two consecutive annual contributions shall be regarded as implying withdrawal of the defaulting Member from the Commission.

3. Any Member of the Commission withdrawing from the Organization or the Office, when such withdrawal results in this Nation no longer being a Member of either of these two Agencies, shall be deemed to have withdrawn simultaneously from the Commission.

ARTICLE XVII

Settlement of Disputes

1. If there is any dispute regarding the interpretation or application of this Constitution, the Member or Members concerned may request the Director-General of the Organization to appoint a committee to consider the question in dispute.

2. The Director-General shall thereupon, after consultation with the Members concerned, appoint a committee of experts which shall include representatives of those Members. This committee shall consider the question in dispute, taking into account all documents and other forms of evidence submitted by the Members concerned. This committee shall submit a report to the Director-General of the Organization who shall transmit it to the Members concerned and to the other Members of the Commission.

3. The Members of the Commission agree that the recommendations of such a committee, while not binding in character, will become the basis for renewed consideration by the Members concerned of the matter out of which the disagreement arose.

4. The Members concerned shall share equally the expenses of the experts.

ARTICLE XVIII

Termination

1. This Constitution shall be terminated by a decision of the Commission taken by a three-fourths majority of the membership of the Commission. It shall automatically be terminated should membership, as a result of withdrawals, comprise fewer than six Nations.

2. On termination of the Constitution all assets of the Commission shall be liquidated by the Director-General of the Organization and after settlement of all liabilities the balance shall be distributed proportionally amongst Members on the basis of the scale of contributions in force at the time. Nations whose contributions are in arrears for two consecutive years and hence deemed to have withdrawn in conformity with Article XVI (2) shall not be entitled to a share of the assets.

ARTICLE XIX

Entry into Force

1. This Constitution shall enter into force upon receipt by the Director-General of the Organization of notifications of acceptance from six Member Nations of the Organization or of the Office, providing that their contributions represent in the aggregate not less than 30 per cent. of the Administrative Budget provided for in Article XIII (1).

2. The Director-General shall notify all Nations having deposited notifications of acceptance of the date on which this Constitution comes into force.

3. The text of this Constitution drawn up in the English, French and Spanish languages, which languages shall be equally authoritative, was approved by the Conference of the Organization on the eleventh day of December, 1953.

4. Two copies of the text of this Constitution shall be authenticated by the Chairman of the Conference and the Director-General of the Organization, one copy of which shall be deposited with the Secretary-General of the United Nations and the other in the archives of the Organization. Additional copies of this text shall be certified by the Director-General and furnished to all Members of the Commission with the indication of the date on which the Constitution has come into force.

Scale of Annual Contributions

Calculated on national income of each country as expressed in the Scale of Contributions to the Organization, the relative position of each country in regard to possible infection with foot-and-mouth disease and the number of livestock to be protected in each country:

Country	Cattle stock 000 heads	Contribution to FAO $	Calculation of Contributions of a $50,000 Budget of the Commission		Scale	
			(*a*) Based on Head of cattle	(*b*) Based on FAO Contributions	Category	Contribution $
Austria	2,279	19,760	1,294·47	434·72	IV	1,500
Belgium ...	2,101	92,560	1,193·37	2,036·32	III	2,500
Denmark ...	3,053	56,160	1,734·10	1,235·52	III	2,500
Finland	1,847	22,360	1,049·10	491·92	IV	1,500
France	15,722	348,400	8,930·10	7,664·80	I	7,000
Germany ...	11,150	245,960	6,333·20	5,411·12	II	5,000
Greece	763	14,040	433·38	308·88	IV	1,500
Iceland	44	2,600	24·99	57·20	VI	250
Ireland	4,322	20,800	2,454·90	457·60	V	750
Italy	8,150	165,880	4,629·20	3,649·36	II	5,000
Luxembourg ...	119	3,120	67·59	68·64	VI	250
Netherlands ...	2,723	88,400	1,546·66	1,944·80	III	2,500
Norway ...	1,236	34,320	702·05	755·04	V	750
Portugal ...	610	33,800	346·48	743·60	IV	1,500
Spain	3,300	71,240	1,879·40	1,567·28	III	2,500
Sweden	2,648	109,720	1,504·06	2,413·84	III	2,500
Switzerland ...	1,530	81,120	869·04	1,784·64	III	2,500
Turkey	10,580	34,320	6,009·44	755·04	IV	1,500
United Kingdom	10,620	781,560	6,032·16	17,194·32	I	7,000
Yugoslavia ...	5,236	34,320	2,974·05	755·04	IV	1,500
Total ...	88,033	2,260,440	50,007·74	49,729·68		50,000

APPENDIX XV

THE ESTIMATED COST OF VACCINATION AND THE COST OF THE STAMPING-OUT POLICY IN GREAT BRITAIN IN THE EPIDEMIC YEAR OF 1952.

Memorandum by the Ministry of Agriculture and Fisheries

The figures given on page 41 have been calculated as follows.

I. The cost of immunising all the susceptible animals in Great Britain.

(i) The total livestock in Great Britain in 1952 was approximately 34,400,000, i.e. 9,300,000 cattle, 20,850,000 sheep and 4,250,000 pigs.

(ii) The cost of one dose of tissue vaccine (made from virus grown in the tongue tissues of slaughtered cattle) is about 2s. 6d. for cattle and about 1s. 3d. for sheep and pigs. Vaccine made from virus recovered from the living animals costs about 5s. 6d. a dose for cattle and about 2s. 9d. for sheep and pigs.

(iii) One dose of tissue vaccine for all the susceptible animals in Great Britain would therefore cost about £2,700,000; if the vaccine were made from virus grown in living animals it would cost about £6 million.

(iv) It is assumed that vaccination would have to be carried out once every four months against each of the three main types of the virus.

(v) It is estimated that in the conditions prevailing in Great Britain one veterinary surgeon can vaccinate 250 animals in a day. Vaccination every four months would thus mean the full-time employment of about 1,100 veterinarians. A conservative estimate of the annual cost of their salaries, travelling and subsistence is £2 million. The cost of vaccination by farmers may be treated as negligible.

(vi) On this basis the approximate cost of vaccinating all the cattle, sheep and pigs three times annually using (*a*) tissue vaccine and (*b*) vaccine made from virus grown in living animals would be as follows:—

	£
vaccine (*a*) injected by veterinary surgeons	26,000,000
vaccine (*a*) injected by farmers	24,000,000
vaccine (*b*) injected by veterinary surgeons	56,000,000
vaccine (*b*) injected by farmers	54,000,000

(vii) The approximate cost of vaccinating cattle only would be:—

	£
using vaccine (*a*) injected by veterinary surgeons	11,000,000
using vaccine (*a*) injected by farmers	10,500,000
using vaccine (*b*) injected by veterinary surgeons	23,500,000
using vaccine (*b*) injected by farmers	23,000,000

II. The cost of stamping-out in Great Britain during 1952:—

	£
(i) Compensation paid for slaughtered animals	2,412,000
(ii) Less receipts for salvaged carcases	387,000
	£2,025,000

To this must be added certain administrative costs, approximately as follows:—

	£
(iii) salaries of staff concerned with outbreaks of the disease ...	170,000
(iv) travelling and subsistence expenses	85,000
(v) cost of labour, burial, disinfection, etc.	170,000
(vi) postage, telephone calls, telegrams, papers, printing, etc. ...	85,000
(vii) local authority and police expenses	100,000
	£610,000
Grand total ...	£2,635,000

February, 1953.

IMMUNITY TO FOOT-AND-MOUTH DISEASE

(Summarised from a Memorandum submitted by Dr. I. A. Galloway, Director, The Research Institute, Pirbright.)

1. Resistance to infection with the virus of foot-and-mouth disease may be (I) natural or (II) acquired as the result of contracting the disease, or (III) induced artificially by injection of a preventive agent such as an immune serum or a vaccine.

(I) Natural Resistance

2. This varies from species to species. There are no authenticated cases of foot-and-mouth disease in the horse and attempts to infect that species artificially have up to now been unsucessful. Dogs and cats are somewhat less resistant, for although they do not contract the disease under natural conditions, they have been infected experimentally by inoculation. While some of the highly susceptible cloven-footed animals like cattle may show occasionally some natural resistance, this is usually slight and can readily be overcome.

(II) Acquired Resistance

3. In susceptible species like cattle, pigs, sheep and goats, resistance to infection with the virus of foot-and-mouth disease can develop as the result of an attack of the disease. The immunity so acquired is variable in duration and is only against the type of virus concerned in the attack, e.g. infection with an O-type virus will lead to the development of immunity to further infection with a virus of the same type but will still leave the animals as susceptible as before to infection with virus of another type such as A or C.

(III) Artificially Acquired Immunity
(which may be classified as either passive or active)

Passive Immunity

4. Passive immunity is the type of immunity in which the resistant state has been acquired as the result of transference from an immune animal of the defensive substances (antibodies) concerned. Such transference can take place under natural conditions, e.g. from cow to calf by means of the colostrum. Passive immunity to foot-and-mouth disease can also be produced by injecting body fluids which have been collected from immune animals and contain the specific antibodies or virus-neutralising factors. The fluids used have included:—

(i) Whole blood collected from convalescent cattle (" Hemo-prevention ").

The resistance conferred by the administration of blood collected from cattle which had recovered from foot-and-mouth disease was demonstrated as early as 1892 by Kitt. Convalescent blood collected 12-15 days after the eruption of vesicles was used on a large scale in several European countries during the 1920-21 and 1937-41 epidemics. The duration of the protection conferred was short (about 10-14 days). Because of the large doses required, the application of the method has been restricted chiefly to young animals, valuable breeding stock or milch cows, to try to minimise to some extent the effects of the disease and to try to limit its spread. While the method was attended with some measure of success in severe epidemics, it had many disadvantages such as the possibility of transmitting bacterial or protozoal infections, the short period of protection given and then only to some of the animals inoculated and against only one immunological type of virus.

(ii) Convalescent Plasma.

The principles involved in the use of convalescent plasma are the same as in the case of whole blood, but the fact that the red blood corpuscles are separated off in preparing the plasma offers some advantages, though the doses required are still large and the protection given is no better than with whole blood. Both these methods have, therefore, fallen almost entirely into disuse.

(iii) Immune Serum and Hyperimmune Serum.

These are prepared from the blood of cattle which have recovered from an attack of the disease or which have been hyperimmunised (i.e. they have been re-inoculated with virus on several occasions after recovery from infection in order to increase the amount of antibodies in the blood). Their preparation demands laboratory conditions. They can be monovalent, bivalent or trivalent, i.e. they can be collected from cattle which have recovered from infection with one, two or three different types of virus. They can have, therefore, a wider application than with blood or convalescent plasma, e.g. they can be used to give some measure of protection to animals going to markets where they might come up against more than one type of virus infection. In Germany immune serum was used extensively prior to 1938 in the so-called " Ringimpfungen " control method, in which immune serum was injected into animals on farms surrounding an infected place with a view to limiting the spread of the disease. In some European countries it is used in the early stages of infection to try to give protection to or at least minimise the effects of the disease on animals which are not showing clinical signs. Since the amount of immune serum available is usually limited, it is used mainly on young animals, sows with suckling pigs and high grade breeding stock. The period of protection is again short and the method has other limitations such as the large doses required, and the difficulty of preparing in time or having available sufficiently large stocks of serum of adequate potency against the different types of virus which may be encountered.

Active Immunity

5. Resistance to disease is classified as " active " when the antibodies responsible have been elaborated by the animal's own tissues. Active immunity may result as indicated above from an attack of the disease contracted under natural conditions of infection but an artificially produced attack will lead to the same result.

(i) Inoculation with active (" live ") virus—(" Aphtisation ").

" Aphtisation " was used by farmers in Europe as far back as 1810 in an endeavour to lessen the time taken by the disease to spread through their stock and thus shorten the period during which they were subject to restrictions on the movement of animals. The method suffered from the disadvantage of producing disease at least as severe as that observed in cattle exposed to infection by contact ; there was also a risk of producing new areas of infection, if it was used indiscriminately. The method is still used to some extent in countries like Africa in which the disease is endemic and where cattle are roaming in unfenced areas in contact with susceptible wild game. Cattle in a known infected area are collected, inoculated with active virus, and held together in fenced-off areas for a few weeks or months. By this means it is hoped to produce rapidly a zone of immunized animals and prevent the disease spreading to other areas. The results are irregular, particularly where outbreaks are due to more than one immunological type of virus. On occasions, owing to the lack of effective means of controlling inoculated stock, the procedure has led to disastrous results and to the spread of the disease into neighbouring territories. In some instances, in an endeavour to avoid such complications, the inoculations have been made with virus attenuated or " weakened " by treatment with mild heat, but the method is of doubtful value.

(ii) Serum-Virus Inoculation (Mixed Immunisation).

The combined use of immune serum and active virus in an attempt to convert the passive immunity given by the serum into an active and more lasting one, without producing a severe attack of the disease, was suggested by Loeffler as far back as 1898. Some workers have tried inoculating a dose of protective serum 1 to 5 days before injecting the virus ; others tried inoculating the serum and virus at the same time but at different points in the body. The results have been uncertain and usually disappointing for it is difficult to adjust the balance between the doses of serum and virus ; if the dose of serum is too large it may completely neutralise the virus and prevent it stimulating the development of an active immunity ; if the dose of serum is too small, severe foot-and-mouth disease may develop in the inoculated animals.

(iii) Vaccination.

There are various ways in which active immunity can be produced without giving an animal the actual disease, viz. by using immunising agents in which the causal organism has been modified, weakened or inactivated by some means. The use of such substances to produce immunity is termed " vaccination ". The foot-and-mouth vaccines in general use are prepared from infected tissues or fluids taken fom a diseased animal in which the virus has subsequently been weakened or inactivated by physical or chemical means or by a combination of both. Attempts have also been made on a limited scale to reduce the virulence of the virus in cattle by transferring it in series from animal to animal using another animal species. The results to date have not been very encouraging but work is continuing in this direction.

(*a*) Vaccines prepared by chemical treatment.

About 25 years ago British and French workers showed that treatment of virus with 0·1 per cent. to 0·5 per cent. formalin at about 26°C. for some 48 hours inactivated it without destroying its immunising value. Limited field tests were made with such vaccines from 1930 onwards by various workers with good but not always consistent results. It proved difficult to determine precisely the conditions of treatment of virus with formalin to ensure the maintenance of immunising potency and at the same time avoid any residual infectivity.

(*b*) Vaccines prepared by physical treatment.

A method of preparing a vaccine which depended on the inactivation of virus by mild heat was suggested in 1939 by Swiss workers and has been utilised for the production of an inactivated blood vaccine. Blood is collected from cattle at the height of infection and, after appropriate treatment (defibrination) to prevent coagulation, the dye crystal violet is added to prevent the development of any contaminating bacteria. The blood is then incubated at 37°C. for at least eight days to render the virus non-infective. Such a vaccine has been tried out experimentally and found to give good protection to cattle when injected in appropriate doses, but to prepare the vaccine it is necessary to use cattle of full susceptibility to ensure that virus is circulating in the blood when it is collected.

(*c*) Vaccines prepared by a combination of chemical and physical means.

The vaccines used to control foot-and-mouth disease in Europe and South and Central America during the last 12-15 years belong to this category. Until recently the virus material used for making such vaccines has been obtained by infecting cattle with foot-and-mouth disease by inoculation of virus into the tongue. The animals are killed 18-24 hours later, when the virus content of the vesicles is high. Virus obtained from the vesicular epithelium and fluid is mixed with aluminium hydroxide and a solution of formalin is added. The mixture is stirred and incubated for 2-3 days at about 26°C. This is the basis of the Schmidt-Waldmann vaccine, but a number of modifications have been introduced from time to time. Since 1947, Frenkel in Holland has developed a practical method of growing the virus in culture in extracts of the tissue cells of the tongue epithelium, and this culture virus can be used satisfactorily for making vaccine.

6. When a vaccine has been prepared, non-infectivity tests must be applied to make sure that it is safe to use ; it must not lead to the development of foot-and-mouth disease when injected into susceptible animals. The vaccine must also be tested for efficacy in protecting susceptible cattle against infection by active virus immunologically similar to that used in the preparation of the vaccine.

7. Although they become rapidly ineffective at room temperature, foot-and-mouth vaccines normally remain potent for at least a year if kept in a refrigerator. Injected subcutaneously, or in some cases intradermally, vaccines

which have been properly prepared and stored can give good protection to cattle against infection with types and strains of virus similar to those used in their preparation. Their use is, of course, complicated by the fact that there are a number of different main immunological types of virus, so that it is necessary to use in their preparation strains of virus of the types required for controlling the disease under the specific circumstances in which they are to be employed. Moreover, recent researches have shown that within these main types there are "variant" strains, which in some cases are sufficiently different in their behaviour to indicate that it may be necessary to select special strains within the main type groups to get the maximum degree of protection possible. It takes about a fortnight for full immunity to develop, and this begins to wane after about six months when a single dose of vaccine has been given. The position with regard to vaccinating animals simultaneously against several strains of virus is not yet completely clear and there is insufficient experimental evidence to support the various claims which have been made in this connexion.

8. Field experience has shown that, even with these drawbacks, vaccines can be useful in certain circumstances in helping to limit the spread of the disease, but much work still remains to be done. It is necessary to try to work out less complicated methods of producing the vaccines and to try to improve their potency and keeping qualities and the durability of the immunity they give. Moreover it is very doubtful whether vaccine prepared from infected cattle is effective in giving protection to sheep and pigs; and much more attention needs to be given to this question. With the solution of these problems, and with improvements in the machinery for determining the type and strain characteristics of viruses associated with outbreaks, it should be possible to use vaccines much more effectively in the control of foot-and-mouth disease.

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